ENGINEERING NEWS

MASSACHUSETTS GRADE CROSSINGS, to the number of 75, have been abolished in the last 10 years, and in the same time 155 new ones made. This is the report of the special commission appointed by the Massachusetts Legislature to inquire into the grade crossing question in that State, and it would plainly seem to be the first duty of the legislative body to stop the construction of new crossings while they are discussing the ways and means of abolishing the old ones. At the above rate of backward progress, the proposed reform will never catch up.

THE ENGLISH TRIP OF THE AM. SOC. C. E. has assumed such proportions as to justify chartering a special steamer for the use of those who have expressed an intention of going. A second circular has been issued by the Society, under date of Feb. 8, calling upon these members to send the full passage money, at the rate $110 for a round trip, so that the Inman Steamship Co. can perfect its arrangements. There will be enough members of the Am. Soc. Mining Engineers and Am. Soc. Mechanical Engineers, jointly, to fill another steamer. May 23 is the probable sailing day of the special steamer. Another proposition is under consideration by the committee from the National Line, at lower rates. CHARLES E. EMERY is the Chairman of the special committee having this matter in charge.

THE PROPOSED NEW CONGO RAILWAY has been surveyed over its entire route, and work on it will probably soon be begun. The length of the route is variously stated at from 200 to 250 miles, the precise length to be built now being still not fully decided; the engineers estimate that it will take two or three years to build it, and cost about $5,000,000. When finished, it will be the most important means yet secured for opening the heart of Africa to civilization, as it operates in connection with steamer lines above and below it. The work of reducing the heart of Africa to civilization is going rapidly forward, more rapidly than is generally appreciated.

THREE FUNERAL CARS for a street railway in Buenos Ayres, Argentine Republic, have recently been completed by J. G. Brill & Co. of Philadelphia, Pa. They are first, second, and third class. The body of the first-class car is painted a rich black, toned with purple, with passion flowers painted on the sides. The windows are of French plate glass. The seats, folding up against the sides, are upholstered in black plush and the window curtains are of black cloth trimmed with gold cord. In the forward end of the car is an altar, with silver cross and candelabra, while on either side of the altar are stained glass windows. The interior of the car is finished in white and gold. The metal work is nickel-plated. On the roof nine large sable plumes are placed. The other cars are simpler and plainer in design, the third-class car having merely a row of shelves for the coffins. The cars are intended to convey bodies, with the mourners, to the different cemeteries. This practice is adopted in the City of Mexico and in some cities of Central America. The only parallel among northern nations is said to be the "dead" train which leaves the Gare du Nord, in Paris, at 5 o'clock every morning, carrying the bodies of paupers and unrecognized persons from the morgue.

A LAND MAKING PROJECT of importance is said to be under consideration, which proposes to make 6 sq. miles of valuable land near the Jersey coast in New York Bay by bringing the solid shore out to Robin's Reef Light. As designed by the army engineers, the filling would take the form of a number of artificial islands with docks on four sides, and an iron bridge connecting these islands with the bulkheaded shore. Careful consideration is called for; and to secure this the Chamber of Commerce has protested against the immediate adoption of the scheme.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was the derailment of a Southern Pacific train near Eldridge, Tex., on Feb. 6. According to the published reports, the engine was on a trestle when a wheel flange broke. It went down 15 ft. in a ravine and dragged after it a baggage car, passenger car, and two sleepers. Some of the passengers were slightly injured and all were severely shaken, but no one was seriously hurt. Two sleepers remained on the track. A good guard-rail system, apparently, would have been useful about that time.

A SINGULAR ACCIDENT occurred Feb. 11 to a train on the New York, New Haven & Hartford near Williams Bridge, N. Y. The Harlem road is making excavations at this point for the purpose of laying 2 extra tracks, and a number of dynamite cartridges had been placed on the ground to thaw, preparatory to a blast. From some cause unknown, or at least not admitted, they exploded at the moment the train was passing. The concussion was so great that the car windows were smashed into fragments and people were hurled from their seats. Broken and powered glass was hurled into the faces of the passengers, many of whom were cut about the faces and hands, but no one was seriously injured.

A CROSSING ACCIDENT occurred Feb. 6 at Covington, Ky. A Chesapeake & Ohio freight train ran into a street car at the Pike St. crossing; the engine was running backwards and the car was thrown up on the tender. There is no watchman at the crossing and the car driver claims that neither bell nor whistle was sounded on the engine. Three or four persons were seriously injured, one of them fatally.

A RUNAWAY DUMMY ENGINE at Denver, Col. caused a serious accident on Feb. 3. It was a steam car, the engine being at the rear end, and was crowded with passengers. The engine had no brakes, although in consequence of frequent warning the company had decided to put them on. At the inquest the engineer, who had been driving stationary engines until he went with the motor company stated as follows: "At the top of the hill I reversed the engine to stop her. A little further down the hill I reversed her again to check her and eased her off again, and when I started to reverse her the third time, the valve chest flew off, which left me without anything to hold the train. There were brake beams and shoes, but they were not connected." The engine ran at a rapid speed down the grade and on striking a curve it jumped the track and turned over. One man was killed and several were seriously injured. The company would have found it cheaper in the end to pay for a good brake when they bought the engine.

EARTHQUAKE SHOCKS continue to be reported from different parts of the world: Feb. 1, in Japan; Feb. 5, in lower South Carolina; Feb. 6, two shocks at Colton, Los Angeles, and San Bernardino, Cal.; Feb. 11, in the neighborhood around Manchester, England.

SNOW BLOCKADES have occurred on the Grand Trunk and the Temiscouata railways, in Canada, and on the Rome, Watertown & Ogdensburg in this State.

NEW RAPID TRANSIT is proposed for New York by the City Railway Co. and under the general railroad law the company is proceeding to acquire property for a 4-track railway. The company was incorporated March 20, 1888, and it proposes to buy its right-of-way though the blocks from No. 1 South St. across Broadway near Rector St. and through the blocks near Broadway to 12th St. and University Place; it will then cross University Place diagonally and follow a line west of Broadway to 59th St. The plan is to rebuild the whole line with fire-proof buildings and put the road in the basement, 12 ft. below the surface of the streets crossed. The tracks will be carried on heavy rails imbedded in concrete to lessen the jar. Electricity will furnish the power, and the cars will be made of woven steel, made solid with a coating of "ferflax," and the frames and sills will be of steel. W. BARCLAY PARSONS, of 35 Broadway, is the engineer, and the surveys and plans for the west side line are nearly completed. Work is in progress for an extension north of 59th St. and from the starting point in South St. for a line east of Broadway to the Hudson river.

THE ARTHUR KILL BRIDGE CASE was again argued before Justice BRADLEY in Washington on Feb. 11. The ejectment suit brought by the State of New Jersey was the one in order, the equity case to restrain the railroad company from building having been previously lost. The attorney for the company declined to answer the elaborate argument for the reason that the company claimed that all points at issue had been decided in the previous decision of the U. S. Court. The State claims that it does not wish to interfere with the bridge, but does wish to assert its claim to the land under water, from which large revenue had been and would be derived under the riparian laws. No opinion was returned by the Justice.

THE PULLMAN PALACE CAR CO. is to have its capital stock increased $5,000,000, according to a vote of the directors at a meeting on Feb. 11. The new stock is to be issued at par to the present stockholders, who will be entitled to subscribe for one share for each five shares now held by them. The market quotation for the company's stock has risen from 150 to 205 within the past few weeks. The proceeds from the sale of the new stock is to be used to pay for the Union Palace Car Co., recently acquired, and for the Atchison, Topeka & Santa Fé Emigrant Sleeping Car Co., and the Atchison's interest in the regular Pullman service over their lines.

THE MEKARSKI COMPRESSED-AIR MOTOR, for street railway purposes, has been taken up in earnest by American capitalists, and an office is established at 30 Pine St., in this city. While the system has been in successful operation in Nantes, France, for 7 or 8 years, and for lesser periods at other points, the car and its mechanism has been remodeled to better suit American needs, and especially with the view of reducing weight. The mechanical appliances are very simple and no skilled labor is required to operate it. The success of this motor is due to the ingenious arrangement by which Mr. MEKARSKI passes the compressed air through superheated water and thus increases its volume and prevents refrigeration in the exhaust ports from rapid expansion of the escaping air. As now arranged, the air reservoirs under the car store 70 cu. ft. of air compressed to 600 lbs. per sq. in. The 224 lbs. of stored (hot) water has an initial temperature of 320° Fahr.; and a consumption of 20 lbs. of the compressed air runs the car 1 mile, providing for a run of 11 miles at 8 miles per hour.

THE PANAMA CANAL, according to a statement made by M. DE LESSEPS at the shareholders' meeting of Jan. 26, is to be built without the two upper locks originally proposed. The amount of capital required to complete the work on this basis is estimated at 400,000,000, "not including interest at 5 per cent." M. DE LESSEPS proposes a commission of engineers to go to Panama and check the estimates.

Paris advices of Feb. 12 say that M. DE LESSEPS is ill and it is reported that he is going to end his days in his villa at Ismaila, in Egypt. Canal shares nominally stand at 56 f. on the Bourse, but with no purchasers. If a new company is formed, it is said that M. CHRISTOPHLE, the governor of the Credit Foncier, will be the President.

THE TEHUANTEPEC SHIP RAILWAY CO., according to a reported interview with Mr. JAMES ANDREWS of Pittsburg, is awaiting certain changes in the concessions granted by Mexico. Mr. ANDREWS feels certain that the action of the Mexican Government will be favorable; and that, with these changes made, European capitalists stand ready to invest in the enterprise. He looks forward hopefully to the successful completion of the Chignecto ship-railway; and says that as soon as its practicability is there established, a number of others are ready to commence operations, including one across Florida.

A FAST RUN was made on February 5, on the Savannah, Florida & Western Railway, a part of the Plant system. The train was the through vestibule express, leaving Savannah daily at 11.01 A. M., and is scheduled to make the run to Jacksonville, 172 miles, in 4 h. 45 min. On this date the run was made in 3 h. 19 min., or an average speed including stops of 51.86 miles per hour. We are not informed how many stops were made, but only four are required by the time-table. The train consisted of an engine, baggage car, and four vestibuled coaches; and the speed is reported to have risen as high as 75 miles per hour on some parts of the run.

THE PROPOSED UNIFORM CLASSIFICATION of freight is making progress, though very slowly. It has been agreed that the number of classes under which freight shall be grouped shall be 12. The next meeting of the committee will be held at Old Point Comfort in April.

A HARLEM RIVER TUNNEL, at Third Ave., is contemplated by the Citizens and Taxpayers' Association of the 23d Ward, New York. Plans have been prepared by Mr. B. R. GUION, C. E., calling for a double-arched tunnel, each arch being 15 ft. span by 15 ft. rise, separated by a 6 ft. wall, with arches 3 ft. thick. This tunnel would be built on a foundation of piles and concrete, by means of coffer-dams. The roof of the tunnel would be 22 ft. below low water, and the estimated cost is $2,500,000 complete. The plan has been referred to the Law Committee of the Association with instructions to draft a bill to be presented to the Legislature.

THE RAILWAY PRESIDENTS interested in the formation of the Interstate Railway Association will hold another meeting in Chicago, on Feb. 19. The Presidents of 15 companies have signed the agreement and the general interest all centers in the question whether the Chicago, Burlington & Northern, and Illinois Central can be induced to join the Association. If so, it is believed that all the other companies who have not yet signed, will do so at once.

THE THURLOW CAST-STEEL GUN, as a result of the official star-gauge test, made after firing, is said to show a permanent enlargement of 4 1000 ins. in the chamber, and 7-1000 ins. near the seat of the projectile. But the test does not seem quite satisfactory, and Com. SICARD has ordered a further examination by electric light and mirror.

A ROAD CONGRESS is wanted by the Georgia weekly press in the interest of a better road system. Some of the papers strongly advocate convict labor under the direction of a competent superintendent who shall be under bonds for the faithful discharge of his duties. This may do for Georgia, where the system of farming out convict labor is already in vogue; but it won't work in other States that need improvement in their roads quite as much as does that State. As to the Congress: we all know now what kind of roads we want, but the problem is how to pay for them. In discussing this question a Congress might do some good work.

THE REED CAR-REPLACER, described in our issue of Jan. 26, is manufactured by the Dunham Manufacturing Co. of 131 Devonshire St., Boston, Mass. As we inadvertently omitted to mention this fact at the time, and queries have been sent to us since regarding its whereabouts, we trust this note will supply the information desired. To avoid confusion with the invention of another Mr. REED, the name of this device has been changed to the Keystone car-replacer.

THE R. J. WILSON HOT WATER HEATER is being tested on a train of 5 cars of the Pennsylvania R. R., according to an exchange. The water is heated in coils of copper pipe in the dome over the boiler and is concentrated by other pipes through the heaters in the cars. Mr. WILSON is a resident of Pittsburg.

A REST ON SUNDAYS is to result from the order of the Pennsylvania Railroad Co. that all freight trains east of Pittsburg and Erie, except such as carry perishable freight and live stock, shall stop at 10 o'clock on Saturday evenings, and that the crews will not return to work until the following Sunday at 7 o'clock P. M. This order will affect over 2,000 trainmen, and will give them a rest each Sunday. This is something that the men have long desired, and if it is found satisfactory to the company after a trial, a similar order will be put in force on the lines of the Pennsylvania system west of Pittsburg and Erie.

THE PHILADELPHIA & READING TERMINAL BILL for elevated tracks in Philadelphia has been apparently effectually pigeon-holed for an indefinite time by the Select Council referring it to a Special Committee of 7 members, 4 of whom are known to be against the bill.

CHINESE SUPERSTITION has caused the issue of an Imperial decree prohibiting further extension of the Tien Tsin railway to Tungchow. The reason given is that a great fire destroyed part of the Imperial Palace in Peking on Jan. 17; and the astrologers after much deliberation declared that the fire was an evil omen and intended as a warning against permitting the nearer approach of the "Western invention" to the sacred city.

AN ELECTRIC HEADLIGHT on locomotives has been on trial for a month past on the Indianapolis, Decatur & Western R. R. It is said to throw a light fully one-half mile ahead, and works very successfully. By improvements in the dynamo mechanism 295 revolutions per minute give as perfect a light as that formerly obtained with 1,300 revolutions, and the expense is proportionately reduced.

A NEW ORLEANS BELT RAILWAY PLAN was adopted on Feb. 7, at the general conference held at the Produce Exchange on that date. The object of the road is to transfer freight-cars, facilitate the handling of freight and passengers, and further the commerce of New Orleans. The franchise is to be let to any corporation that will agree to construct it under the terms fixed at the meeting. It is to be controlled jointly by the railroads interested and the city; and the city is to receive a sum not exceeding 50 cts. for each loaded car or locomotive not drawing a train hauled over the road. It will be a surface road connecting the present widely separated lines, and a union depot may form part of the scheme.

A 5-MILE TUNNEL is planned, and the estimates have been submitted to the Italian Minister of Public Works, for the fifth section of the Cuneo & Ventimiglia railway, which includes the passage of the Col de Tende. The whole section is only 6¾ miles long and the cost is estimated at $4,688,000.

THE UNITED STATES NATIONAL MUSEUM, at Washington, D. C., has recently received from the Baldwin Locomotive Works a miniature model of the "Old Ironsides," which was built in 1832 by MATHIAS BALDWIN, being the first locomotive built by him. This engine is said to have attained a speed of 60 miles an hour. The section of the museum devoted to transportation and engineering contains collections illustrating methods of transportation by road, rail, and water in different countries. The collection illustrating the development of the locomotive contains the original "John Bull" engine.

THE PROPOSED ELM ST. IMPROVEMENT, in this city, is again being taken up by a new board, which had its first meeting on February 12. A number of interested parties were heard, and among them M. C. H. KITHEL who claimed to represent property holders to the extent of $4,000,000, who asked for it. Hon. O. B. POTTER thought that if the City paid for the whole improvement, it would get back the money in 25 years in the increased taxable value of property. An early decision of the east-side traffic question is promised.

THE ABOLITION OF GRADE CROSSINGS, asked for by the railway commissioners of New York in the bill they have lately submitted to the Legislature, is based upon the fact that they regard these crossings as the chief cause of railway accidents. They report that in 1887 42 persons were killed and 57 injured in the State of New York at railway crossings; and in 1888 the killed numbered 28, and 34 were injured. In Hudson county, N. J., during the last 10 years, 454 people lost their lives from this cause alone. For the 3 years ending and including 1887, there were 133 persons killed in this way in Philadelphia. In 1887 the record was 19 killed in Massachusetts, and 26 were killed on only 3 railways in Chicago in the same year.

THE BIRMINGHAM "EXTINCT VOLCANO," proves to be a "fake," gotten up by a local reporter of that wide-awake Alabama town. Whether the report was started to boom "the natural resources" of Birmingham, as we suggested at the time, or was simply a piece of reportorial cussedness, is not stated.

THE "FENLAND" of England covers about 800,000 acres in the counties of Lincoln, Northampton, Cambridge, Huntington, Norfolk, and Suffolk, almost the whole of which is below the level of high-water of spring tides. And about 360,000 acres lie so low that constant pumping is required to relieve this area of rainfall of water. At one time 500 windmills did this work in Fenland; but steam-power has replaced all but about 50 of them. The steam engines drive either centrifugal pumps or scoop-wheels; the latter being something like an undershot water-wheel, with the difference that it pushes the water *up* the race instead of being rotated by water coming *down*.

The Pacific Railroad Problem in 1849.

Lying before us is a pamphlet published by Mr. ASA WHITNEY in 1849, entitled a "Project for a Railroad to the Pacific." It includes the map here reproduced, and is devoted to setting forth the national and commercial advantages of such a railway line and the means which Mr. WHITNEY proposes as the best fitted, in his judgment, to accomplish the desired end.

This document is particularly interesting when we remember that when it was issued the railways of this country only aggregated 7,365 miles in length, the present great trunk lines were only projects in the brains of a few far-seeing men, and even the Pennsylvania Railroad was still broken at the Alleghenies mountains. The great and only Chicago has no place on this map, although it even then had about 30,000 inhabitants, and the comparatively insignificant St. Joseph was made the starting point of a system of railways extending to the far west by way of Prairie-du-Chien. The many lines extending over this map are simply projects: none of them then existed, except in very small part in some cases. But it is also interesting to note how very closely some of these follow the path of lines actually built in the 40 years that have passed. This is particularly true of the North, Union, and South Pacific lines; and other routes there laid down have an existence to-day in proposed lines and extensions of existing roads. Mr. WHITNEY selected Prairie-du-Chien as his crossing point because it was then believed that that was the lowest point on the Mississippi river where a bridge was feasible; and while the Hon. THOMAS. H. BENTON, who was working first and last for the interest of St. Louis, looked upon the railroad as an adjunct merely to steamboat navigation, Mr. WHITNEY wanted his line across the Continent to be all-rail, as it is to-day.

The pamphlet referred to covers 112 closely printed pages, and space forbids any but the most meagre abstract of its contents. But as Mr. WHITNEY here distinctly claims to have been the originator of a project for a railway to the Pacific, we will first give his plans and what he says concerning his connection with this great enterprise, and afterwards briefly discuss the question of priority between himself and some other claimants.

From the context it would appear that Mr. WHITNEY was seized with his idea sometime previous to 1844, for in that year he says he returned from China "resolved to devote my life to the work which I believed promised so much good to all mankind; doubting not that I could in time satisfy my countrymen of its perfect feasibility and of its vast importance." He personally, and at his own expense, examined, in 1845, about 1,500 miles of the Missouri river and other parts of his proposed route; he made use of a two-years residence in Asia in gathering statistics and speculating on the probable foreign traffic that might be expected over such a route, and at the second session of the 28th Congress he presented a memorial advocating his views—a memorial which was favorably reported upon by committees of both Houses. He again sent a memorial to the 29th Congress, which, though it was favorably reported upon by a Senate committee, was attacked by the Hon. THOMAS H. BENTON "in a boisterous and unparliamentary manner." The bill failed to receive any further consideration, owing to the influence of Mr. BENTON and to the California bill, which was then absorbing the attention of Congress.

Mr. BENTON, though at first, in 1846, advocating a water route via the Missouri and Columbia rivers, changed his mind later, and thought that "the time had come, and we must have a railroad at once." But Mr. BENTON maintained that it must be built by the Government, and must have its termini in St. Louis and San Francisco.

Mr. WHITNEY took Lake Michigan as his starting point; and his first line crossed the Mississippi river at Prairie-du-Chien, "where the river can be bridged," and thence to the South Pass. From the latter point he selected the south route around Salt Lake instead of the north line built upon, and in his selection he was in accord with later engineers of very considerable eminence. It will be seen that for all practical purposes, very much of his line

covers the route of the existing Union and Central Pacific, the first of the transcontinental routes constructed. He estimated the length of the line from Lake Michigan to the Pacific Ocean as 2,030 miles. The rail was to weigh 64 lbs. per yd., the gauge to be not less than 6 ft., and the cost was figured at $20,000 per mile; and allowing for plant and expenses of operating before the line was formally opened, he put the total cost ready for use at $60,000,000.

Mr. WHITNEY did not believe that Congress would ever appropriate money for such a work; and he thought that there were many and serious objections to carrying it on by the State or general Government. He believed that under national control, it would be made a sectional question between North and South; that the money would be squandered upon "the hirelings of aspirants to office," and it would cost at least four times as much as if built as a private enterprise, etc.

His plan was to build the railway from the proceeds and improvement of the land traversed, land which was in 1849 practically without value to the general Government. He asked Congress to sell to him, not to grant, 60 miles in width of the public lands from Lake Michigan to the Pacific Ocean, in all, good, bad, and indifferent land, 77,952,000 acres, at a price fixed by a committee of Congress at 10 cts. per acre. The first 800 miles of the route crossed was land of the best quality for agriculture, and upon this 800 miles the entire project was to depend. To accomplish his purpose Mr. WHITNEY proposed to survey and locate 200 to 300 miles of road as soon as the bill became a law, so as to secure the land. He would then let the contracts for grading; and upon the certificate of a Government commission that the first 10 miles was well and properly constructed, he was to be permitted to sell a tract, 5 miles long by 60 miles wide, or one-half of the completed line. These 192,000 acres, at 72 cts. per acre (the then price for land under soldiers' bounties) would amount to $138,240.

But the 10 miles of railway would cost $20,000 × 10 = $200,000 to build, and the builder consequently must, by "his energies, efforts, and labor," make the land bring more money than that for which it could then be bought from the Government, *i. e.* 72 cts. per acre; and not only this, but the other 5 miles remaining in the hands of the Government would be raised equally in value, if the presence of the railway would enhance the value of the land traversed to the extent Mr. WHITNEY believed it would. The reserved sections were to be devoted to aiding construction through the poor lands, where the 10 miles by 60 miles, or 384,000 acres, could not be sold for enough to meet the cost of construction. In such a case only so much of these alternate reserved sections were to be sold as would meet the deficiency. Until the whole line was completed the Government would hold the road and all surplus lands, if any, as surety for the payment of 10 cts. per acre for all land embraced in the 60-mile strip across the continent.

Asa Whitney's "Project for a Railroad to the Pacific." Published in New York in 1849.

The original bill further provided that the Government was in no way to be responsible for maintaining or operating the road; that the mails were to be transported free, and that Congress should always have the power to regulate and fix tolls. If the sale of lands fully paid for the construction and the sum required for the original territory, then Congress was to reduce tolls so as to only provide for necessary repairs and operation. It was then to be a national, and as much as possible, a free road with tolls not exceeding one-half those charged on dividend-paying railways in other parts of the United States. The passenger rate from the lake to the ocean was not to exceed $20; for one bushel of corn, 25 cts.; for one barrel of flour, $1,00; one ton of merchandise, $10; and one ton of measurement of teas (⅓ ton weight) $5. Mr. WHITNEY believed that these low tolls would forever secure to the Mississippi Valley "the markets of all Asia, and also force the commerce of Europe with Asia to pay tribute to it." He figured that at this rate corn could be put down in China for 40 cts. per bushel transit, and a demand created for millions of bushels. To earn dividends the road must double its tolls, and thus exclude this profitable traffic. If the road was to be built from an investment of capital not connected with the sale of land and the settlement of the country, Mr. WHITNEY estimated that it would cost $200,000,000 or more, and tolls would have to be charged in proportion.

The bill also provided that all surplus lands were to be sold at public auction within 10 years after the railway is completed through any section. Mr. WHITNEY was to take all the risk and entire responsibility, and his profit was to be solely in the enhanced value of the land remaining after the cost of construction was fully met.

The map shows upon it a number of projects and possible lines, and also lines of *proposed* railways in the section east of the Mississippi river. The route laid down from St. Louis to San Diego was the result of an amendment proposed to the original bill by Mr. FOOTE of Mississippi. Mr. WHITNEY believed it would be "a route of travel but not of commerce." As the climate of San Francisco was then deemed so much warmer than that of the Atlantic coast that it might interfere with the commercial purpose of the road, Puget Sound was suggested as perhaps a better Pacific shipping point. The distance from the South Pass was about the same whether the line terminated at San Francisco or Puget Sound.

The House Committee of the 30th Congress, in reporting and approving Mr. WHITNEY's bill, said that of the 2,030 miles, 800 miles were good land, though 500 miles of it was without timber, and that it was only by the building of such a railway that this immense country could ever be made of use to man or valuable to the nation. The committee thought that 16 cts. per acre, as originally proposed by Mr. WHITNEY, was too high, and they reduced the amount to be paid by him for the virgin land to 10 cts. as given in the bill.

A voluminous appendix to this pamphlet testifies to the industry of Mr. WHITNEY in gathering all manner of statistics relating to his project, and in showing, by favorable resolutions passed almost unanimously by the Legislatures of fifteen States, and a number of the chief cities of the Union, the extent to which this energetic man had enlisted public attention to and sympathy with his plans for a Pacific railway.

Now as to the question of priority in suggesting the connection of the Pacific ocean and the Mississippi valley by a railway. In his excellent "History of the Northern Pacific Railway," Mr. EUGENE V. SMALLEY has very thoroughly discussed this question, and from this and other sources the case may be set out about as follows:

The first hint at a railway line across the Continent seems to have emanated from the Rev. SAMUEL PARKER, a Presbyterian minister of Ithaca, N. Y., who was sent out as a missionary to the Indians of the Northwest in 1833. In 1835 Mr. PARKER joined an expedition of the American Fur Company under Capt. FONTANELLE, and with this party proceeded, by way of the Black Hills, Green River Fort, Walla Walla, and Fort Colville, to Astoria. On his return soon after, he wrote a book recounting his travels, and in describing the country traversed he says: "There would be no difficulty in the way of constructing a railroad from the Atlantic to the Pacific ocean." He based his opinion upon the passes over the mountain found, and upon the lighter snows of the more northern regions. This early prophet of a transcontinental line died in Ithaca, N. Y., in 1866, aged 87 years.

The next writer upon this subject, and one who looked upon the project from a patriotic rather than a commercial standpoint, was Dr. SAMUEL BANCROFT BARLOW of Granville, Mass., who, certainly as early as 1838, commenced the publication of articles favoring a railway from New York to the Columbia river. His main object was to better secure our then disputed rights in Oregon and to encourage the settlement of the vast Western plains. In the *Intelligencer* of Westfield, Mass., of an unknown date, but from the context apparently about 1833-34, a letter of Dr. BARLOW appears which locates his railway about on the 46th parallel. He assumes a length of 3,000 miles and an average cost per mile of $10,000: this would make the total cost $30,000,000, and he estimated that it could be built by the Government, as he proposed, in 3 or 4 years. In this letter he points out the great advantages of such a means of communication, and puts the traveling time between New York and the mouth of the Columbia river at 12½ days. He also lays great stress upon the East Indian commerce that could be expected from such a pathway across North America; and, in fact, uses very much the same arguments later employed by Mr. WHITNEY. Dr. BARLOW died in 1876.

Mr. ASA WHITNEY next appears in the field, and is certainly entitled to the credit of putting this project before the people in a practicable shape, and of attracting widespread public attention to the possibilities suggested by his plans. He, as before said, used very much the same arguments in its favor as did Dr. BARLOW; but he went further in formulating definite schemes and in presenting bills to Congress, which were wel. received and favorably reported upon. He was active and aggressive, and as might be expected under these conditions, met with very considerable opposition from parties who thought they saw somewhere in the bill a "land-grab" of colossal proportions; others of that day looked upon a project to build 2,000 miles of railway through an utter wilderness as the wildest folly, especially as they "could not build one over the Allegheny Mountains." WHITNEY's bill did not provide for a corporation, but made him and his legal heirs personally responsible for the construction of the road for a salary of $4.000 per annum, and such profit as might come from the enforced sale of land included in the original grant, if any such land remained. After it was built, the Government was to regulate the tolls totally for the benefit of the users of the road regardless of profit. WHITNEY was very much in earnest in his scheme, and spent his fortune in pushing it and combating rival projects. He is said to have spent the later years of his life in selling milk, and to have died very poor.

Rival projects cropped up in several directions about 1849 (the date of our pamphlet), and among these the most conspicuous were the following: The National Pacific Railway was devised by GEORGE WILKES of New York, and was advocated by Hon. WM. H. SEWARD. A line was projected by Hon. THOS H. BENTON, commencing at St. Louis and passing by way of Pueblo to San Francisco, with a branch line to Oregon. And at the Pacific railway convention held in St. Louis, in the fall of 1849, where all these schemes were presented, Mr. J. LOUGHBOROUGH of St. Louis offered as a compromise to run a line from Independence, Mo., to the South Pass, and thence by the Humboldt river to California, and to Oregon, with a terminus at Fort Vancouver. As WHITNEY had foretold in his pamphlet, the question became a sectional one to a very considerable extent, and while Senators BENTON of Missouri and FOOTE of Mississippi fought for a Southern line, nowhere north of the 35th parallel, Northern representatives battled just as stoutly for the opening of the great plains of the Northwest.

But when WHITNEY had given up his scheme in despair, he found an able successor in Mr. EDWIN F. JOHNSON, who was an experienced engineer, a close student of public questions, and a man who studied the problem from an engineering rather than a speculative standpoint. Mr. JOHNSON was born in Essex, Vermont, in 1808, and was the son of a civil engineer, if the term can be used so early in our history of mechanical progress. As early as 1826 he strongly advocated the building of a railway from the Hudson to the Mississippi river, and in 1831 published a pamphlet upon this subject and distributed it among all the towns and villages lying on the route he proposed. This scheme has been looked upon as, and probably was, the inception of the New York & Erie R. R., of which Mr. JOHNSON was Chief Engineer in 1836. In 1852 he was the Chief Engineer of the Chicago, St. Paul & Fond du Lac Railway, later known as the Chicago & Northwestern, which originally ended at St. Paul. But JOHNSON earnestly advocated an extension to the Pacific coast, by way of the Missouri and Columbia rivers, and wrote an article on his project for *Poor's Railroad Journal*. Mr. JOHNSON died in 1875.

The Government now commenced to take more lively interest in the matter, and in 1853 Congress sanctioned an official survey of the various proposed routes, 5 in all. One line was surveyed near the 32d, another on the 35th, and three others between the 38th and 39th, 41st and 42d, and 47th and 49th, parallels of north latitude. JEFFERSON DAVIS was then Secretary of War, and it is claimed that it was through his efforts, and in the interest of the South, that the direction of these surveys was placed with the War Department. In any event, when the result of these surveys was presented to Congress in 1855, Secretary DAVIS recommended the 32d parallel route as the route easiest to build and the safest from snow obstruction. Sectional jealousies delayed matters again until the war of 1861-65 broke out and left the inauguration of a railway to the Pacific practically in the hands of the North. The Union Pacific Railway, as it is now called, and the first to lay a line of rails across the continent, was chartered by Congress July 1, 1862, and opened May 10, 1869. Its further history is too recent to form any part o this article.

ASA WHITNEY's project was kept alive until 1852 and its last appearance was in the shape of a compound plan of WHITNEY, S. L. SELDON, and R. I. SCOTT, to build a railway from the west bank of the Mississippi, not further north than Memphis, to Rio del Norte and to the Pacific at San Francisco. This, like his other projects, proved abortive, and, as before mentioned, he then gave up in despair. Mr. SMALLEY, in summing up the claims of the various early projectors of a Pacific railway, gives the first place to Dr. BARLOW, who was moved by theoretical and patriotic motives. WHITNEY came next, and gave the project form as a public movement, and brought it prominently before the various States and Congress. But it was JOHNSON who first attacked it as an engineering problem, and placed it upon a practical basis by showing the actual advantages of the route for railway construction and the value of the land to be traversed for settlement.

SNOW AND ELECTRIC RAILWAYS.—There are many people who, although believers in the practicability of the electric railway, are yet inclined to be a little sceptical as to its operation in localities where snow and ice are prevalent. The performance, however, of some of the railways operating the Thomson-Houston system during the recent snow storms has clearly proved that the snow and ice offer little, if any, opposition to their working. On Saturday, Jan. 20, there was a heavy fall of snow in Scranton, Pa., which at 9 P. M. had accumulated to a depth of about 6 ins. On Sunday the cars made regular trips, which on that day are made hourly. On Monday morning it was found that there were many heavy drifts, but these seemed to offer no impediment to the first car to go over the line, which plowed its way through them in a way that leaves no doubt as to the ability of these cars to operate in stormy weather. On the grades of 4½ and 5 per cent. the snow was even deeper than on the level, but in spite of this the cars made their trips on schedule time. The operation of the cars was the subject of universal favorable comment. At Des Moines, in the middle of December, about a foot of snow fell, but it had no effect on the electric cars, which made regular trips every 15 minutes; in fact, the electric railway was the only tramway in Des Moines which was able to operate on schedule time during the storm.

The Poughkeepsie Bridge.

The general view given of the Poughkeepsie bridge across the Hudson is from a photograph kindly furnished by Mr. JOHN F. O'ROURKE, the engineer for the Union Bridge Co., the builders of the bridge. We have previously given so much of the detail of this structure as it was in progress that it is now only necessary to say that, excepting a very small portion of the approach viaduct on the east, the metal-work is complete. Work upon the railway connections and extensions required to utilize this crossing of the Hudson, are progressing rapidly on both sides of the river; and early spring will probably see the opening of the whole line to traffic.

Covered Reservoirs.*

BY CHARLES H. SWAN.

Ancient Covered Reservoirs.—Covered reservoirs have been used for the storage of water from periods of great antiquity. They have been constructed of various sizes and shapes, from the small cisterns supplying single dwellings, to the large reservoirs of ancient fortified cities and of modern municipal water-works.

During recent excavations at Jerusalem,† many ancient reservoirs have been discovered. Those which appear to be the oldest, and of very great antiquity, were formed by sinking deep wells through the rock and then making an enlargement at the bottom to act as a collector. Second in antiquity are the cisterns with natural roofs. These were excavated in a stratum of softer rock, the overlying harder stratum serving as a roof. A third class was formed by excavating the rock and covering the opening with an arch. A fourth class, modern, were built amid the loose débris, the accumulations of the centuries, which forms a large portion of the site of the modern city. It is estimated that the ancient subterranean cisterns, in the vicinity of the temple alone, contained upwards of 10,000,000 galls. One of them, known as the Great Sea, is said to have had a capacity for 2,000,000 galls. Numerous other cisterns, some of them of large capacity, have been discovered, excavated in the rocky hills of the vicinity.

Although foreign to the immediate purpose of this paper, it may be interesting to mention a few facts relative to the ancient water supply of the city. Besides the water furnished by springs and wells, and by the collection of rain-water, there was a large supply brought from a distance by aqueducts. The remains of two such aqueducts are in existence—one the high-level, the other the low-level. The latter was over 40 miles in length, and still carries water as far as Bethlehem. It corresponds in length with an aqueduct known to have been built by Pontius Pilate, but it cannot be fully identified. The high-level aqueduct drew its supply from a tunnel 4 miles long excavated in the rock beneath the bed of a valley on the road to Hebron. Near Rachel's tomb it crosses a valley by means of an inverted syphon, 15 ins. in diameter, formed of large perforated blocks of stone set in a mass of rubble masonry. The joints seem to have been ground. They are united with an extremely hard cement. This aqueduct cannot be traced within some miles of the city, but it is supposed to have entered near the northwest corner and to have supplied the upper part of the city.

These brief statements, which are from the published accounts of the work of the Palestine Exploration Fund, show, as do the remains of Roman water-works at Lyons, France, that the principles of hydrostatics were known to the ancients, who were prevented from applying these principles extensively by the difficulty of obtaining, in those days, pipes of sufficient size and strength to convey large volumes of water under heavy pressure. The familiar arrangement of separate aqueducts under different heads for supplying high and low districts is also seen to date from a very remote period.

Many fortified cities of antiquity were provided with subterranean reservoirs to supply water during sieges. The ancient cisterns of Constantinople are reported to have contained a supply for 1,000,000 men during 4 months. Several of them are still in existence. Other ancient covered reservoirs might be mentioned, but these examples are sufficient to indicate their magnitude and importance.

Modern Covered Reservoirs.—The covered reservoirs of modern water-works owe their origin to the necessity for maintaining the purity of the supply when it is stored in the vicinity of large cities. The effect of covering is:

1. To protect the water from solar heat and light, thereby securing uniformity of temperature and preventing the growth of vegetation.
2. To protect the water from atmospheric impurities.
3. To prevent malicious pollution.

These three classes of evils vary in relative importance in different climates and localities.

Effects of Light and Heat.—It has for many years been recognized that the water derived from certain subterranean sources is peculiarly liable to be invaded by vegetable growths upon exposure to the light and heat of the sun in open reservoirs. Examples of this action have been found in water from various geological formations, both in Europe and in the United States. Apparently, such water contains principles which do not affect its clearness or limpidity, but which promote vegetation upon exposure to the light; rendering the water unsightly, and frequently developing a disagreeable taste and odor. The examinations of the water supplies of towns now being made by the Massachusetts State Board of Health will, it is hoped, furnish an explanation of this curious fact.

An interesting illustration of the effect of excluding sunlight from a water derived from subterranean sources, and which had caused complaint, is given by Mr. G. H. Parker in a recent report,* some of the details of which are as follows:

The town of Brookline is supplied with water from a covered filter gallery. The water is pumped into two reservoirs, one of which is an iron tank supplying the high service. Complaint having been made that the water supplied from these reservoirs had an offensive taste and smell, while the water in the filter gallery, which was in darkness, remained free from any disagreeable qualities, it was deemed advisable to cover the high-service tank with a double roof, and ascertain whether the exclusion of light would prevent the development of the unpleasant changes.

Examinations made subsequent to the covering of the tank showed that, while the water in the filtering gallery continued to be clear, free from green algæ, and devoid of disagreeable taste or smell, and while the water from the open reservoir continued to show "an abundant supply of green algæ, was slightly cloudy, and had a very strong taste and decidedly fishy smell," the water from the high-service tank, "now completely darkened, contained only one specimen of green algæ, was now free from odor and taste, and for all practicable purposes as good as that pumped at the filter gallery." It was concluded that the exclusion of light would be a complete remedy for the unpleasant effects, and the construction of a covered reservoir is contemplated.

Similar conclusions have been reached in England. THOMAS HAWKSLEY, the celebrated English engineer, testified in 1852 before the Select Committee on the Metropolis Water Supply Bill, that water taken from the new red sandstone was peculiarly liable to the growth of algæ if it was exposed to the sun, but that the exclusion of light and heat was a complete preventive. He also said that he had recommended covering a reservoir at Liverpool, a short time before, to avoid these unpleasant results.

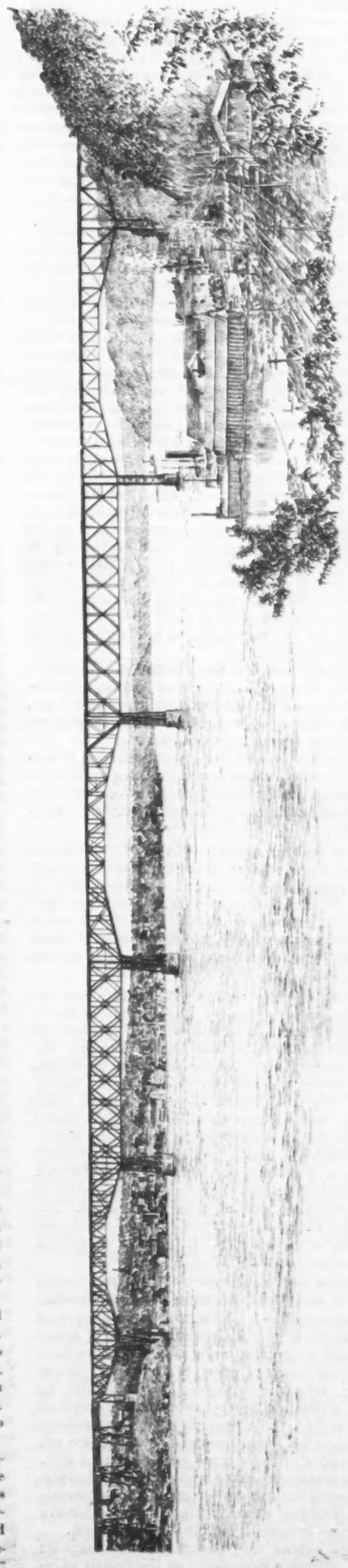
The water of lakes and rivers may also be invaded by growths of algæ under favorable conditions. This growth is greatest in shallow open reservoirs or ponds, where the water is comparatively still, and where it is exposed to a considerable elevation in temperature. In reservoirs exceeding 12 or 15 ft. in depth, the growth does not appear to be so troublesome.

Atmospheric Impurities.—The danger of pollution from atmospheric impurities is greatest in the neighborhood of smoky cities. At London this was formerly the source of great annoyance. The surface of the water in reservoirs was often covered with a film of soot and dust, and if the water re-

*From the *Journal of the New England Water-Works Association*, September, 1888.

†The Recovery of Jerusalem. New York, 1871.

*Massachusetts State Board of Health. Nineteenth annual report. Boston, 1888.



North View of the Poughkeepsie Bridge. From a Photograph.

mained in the reservoir a sufficient time, it acquired a bitter flavor.

The General Board of Health, in its report in 1852 on the supply of water to the metropolis, in consideration of this trouble, and also of the fact that filtered water after exposure in open reservoirs frequently had to be strained before it could be used for domestic purposes, on account of growths of algæ in the reservoirs, arrived at the following conclusion: "Against the modern engineering practice of exposed and open reservoirs, we would rather revert to the custom of the Roman engineers, and recommend covering the service reservoirs and aqueducts to the utmost extent practicable."

Influenced by similar considerations, the Select Committee of the House of Commons reported a bill, which was passed July 1, 1852, containing the following clauses: "Every reservoir within a distance in a straight line from St. Paul's Cathedral in the City of London of not more than 5 miles, in which water for the supply for domestic use of the metropolis or any part thereof is stored or kept by any company, shall be roofed in or otherwise covered over: Provided always, that this provision shall not extend to any reservoir the water from which is subjected by the company to efficient filtration after it is discharged from such reservoir and before it is passed into the mains or pipes of the company for distribution, or to any reservoir the whole of the water from which is distributed through distinct mains or pipes for other than domestic purposes, nor to any reservoir whatever, the water stored in which shall be used exclusively for other than domestic purposes. . . . No water shall be brought or conducted within the metropolis by any company for the purpose of domestic use otherwise than through pipes or through covered aqueducts unless the same shall be afterwards filtered before distribution."

English engineers, having in mind the conditions obtaining in England, appear to regard protection against soot and dust as the most important point, although they by no means ignore the importance of protection against heat and light.

French engineers, on the other hand, seem to consider protection against solar influences as the most important. This naturally follows from the fact that French cities are much less smoky than English cities.

The atmospheric conditions in the United States resemble those of France, although there are localities in this country which are as smoky as any in England. The need of covered reservoirs has been felt here for several years, especially since the use of ground-water as a supply, and the practice of filtering, have become common, and several have been constructed.

Methods of Construction.—A covered reservoir does not usually present any serious difficulty to the engineer. It should be built of materials that are durable and not liable to injure the quality of the water. Iron has been used for pillars, girders, or covering; but its use is to be avoided on account of its liability to corrosion. Small reservoirs may be covered with ordinary roofs or sheds; but these do not usually afford a sufficient protection against the heat. The best and most usual covering is of masonry or brickwork covered with a thin coating of asphalt to prevent the percolation of surface drainage, and of a layer of earth. The numerous covered reservoirs near London are mostly built in this way. It is usual to provide numerous ventilators.

The shape and constructive details are greatly dependent upon local conditions. The following types are common:—1. A circular reservoir covered with a flat dome. 2. A circular reservoir of larger size divided by circular walls into several annular compartments each of which is arched. 3. A rectangular reservoir divided longitudinally by straight walls into several compartments each of which is arched. 4. A reservoir covered by groined arches supported upon masonry piers. There are also variations of these types made by using iron. It is very common to make openings in the division walls, thereby uniting two or more compartments. In some instances these openings are so extensive that the wall becomes virtually a series of piers.

It would extend this paper to unwarrantable limits to attempt a description of the details of reservoirs of these various types, but it will be interesting to give descriptions of two covered reservoirs recently constructed at Mulhouse, Germany, and of the two-story reservoirs of Paris, which consist of one covered reservoir superimposed upon another.

MULHOUSE. This city is situated between the source of supply and the hill upon which the reservoirs are built, the water being pumped directly into the distribution pipes.* Its topography requires a high-service as well as a low-service system. The low-service reservoir is so placed that its bottom is 35.85 metres (117.6 ft.) and its maximum water level is 39.65 metres (130 ft.) above the mean level of the streets. The high-service reservoir, situated 50.88 metres (167 ft.) above the low-service reservoir, furnishes water to a limited suburban district containing a population of only 130 persons; about one-third of the area of the high-service district being cultivated as gardens. The upper reservoir is supplied by pumps from the lower reservoir. It has a capacity of 1,800 cu. m. (475,000 galls.) which is the estimated maximum consumption for one day.

The low-service reservoir has a capacity of 10,000 cu. m. (2,640,000 galls.) which is about two-thirds of the maximum daily consumption. It is excavated in the earth, arched over and covered with earth. It is formed of two perfectly similar compartments, each being 38.6 metres (126.6 ft.) long and 35.2 metres (115.4 ft.) wide. The walls on the sides which receive the thrust of the arches have a thickness at the base of 2.5 metres, (8.2 ft.) reduced by steps to 1.35 metres (4.4 ft.) at the top. The walls on the other sides have a mean thickness of 1.15 metres (3.9 ft). The wall separating the two compartments is 2 metres (6.6 ft.) thick at the base and 1.5 metres (4.9 ft.) at the top.

The covering arches are cylindrical, and are built of brick and cement in circular segments of 5 metres (16.4 ft.) span and 1.2 metres (3.9 ft.) rise. They are 35 cm. (14 ins.) thick at the springs and 23 cm. (9 ins.) at the key. The intermediate walls which support the arches are themselves pierced with arched openings which allow communication between the different bays. The pillars which are left between these openings are of brick and cement masonry. The skewbacks are all of cut stone. The exterior walls are of rubble masonry laid in hydraulic lime and lined with brickwork. The bottom is formed of a bed of concrete of hydraulic lime 35 cm. (14 ins.) to 85 cm. (33½ ins.) in thickness, covered with a course of bricks laid on edge in cement. The faces of the walls and pillars, the bottom of the reservoir and the intrados of the arches are covered with a smooth plaster of Portland cement 2 cm. (1 in.) in thickness, all the angles being rounded. The bottom has a grade of 0.002 towards the drainage openings. The extrados has received a covering of cement 3 cm. (1¼ ins.) in thickness, and has been covered with one metre (3.3 ft.) of earth. Drainage pipes are laid in the hollows of the arches to lead off the water of the soil. The walls on two sides are covered externally with a sloping embankment and turfed. The earth covering the top of the reservoir is cultivated as a garden, and is used as a public promenade. The interior of the reservoir is aerated by 27 ventilators emerging from the soil and covered with caps of galvanized sheet-iron, so arranged that nothing can be put in from the outside.

The influent pipe, which is also the effluent pipe, divides into two on reaching the reservoir, and each branch runs to the middle of one of the compartments. This arrangement is to facilitate the circulation of the water in the reservoir, whether it is flowing in or flowing out. A pipe 50 cm. (20 ins.) in diameter, with a valve, passes through the division wall and permits a communication between the two compartments when desired. The depth of water is 3.8 meters (12.5 ft). There is an overflow pipe and a drainage pipe in each of the two compartments. These pipes unite in a single one of 25 cm. (10 ins.) diameter, outside the reservoir, discharging into a sewer after passing a trap which prevents any emanations from the sewer entering the reservoir.

All the pipes issuing from the reservoir pass through a chamber, in which are the valves. The facade of the structure forming this chamber is an Ionic portico in white stone, surmounted by a balustrade at the level of the top of the reservoir. The interior of the reservoir is entered by means of two circular iron stairs 1.4 meters (4.6 ft.) in diameter. To reach the top of the reservoir, in coming from the city, there is a stone staircase of several flights built in the slope of the embankment.

The high-service reservoir is also excavated in the earth and covered with a metre of soil. It is in two compartments of 16 metres (52.5 ft.) by 17.53 metres (57.5 ft.) each, which are divided into 4 bays 4 metres (13.1 ft.) wide by means of walls of brick and cement 50 cm. (20 ins.) thick. These walls have openings 4 metres (13.1 ft.) wide alternately at their extremities, so that the water, being led to the side opposite that at which it will flow out, has to traverse all the bays before reaching the orifice of exit. Stagnation of the water is thus prevented. This precaution is necessary in a reservoir of this kind, where the quantity of water to be supplied is very small, and even nothing during several consecutive days. The least work of the pumps thus sets in motion all the water contained in the reservoir.

The walls forming the sides have a thickness of 2.50 (8.2 ft.) to 1.75 (5.7 ft.) metres, those of the ends 1.15 metres (3.8 ft.). The arches supported by the intermediate walls and by the longitudinal walls have a span of 4 metres (13 1 ft.) 75 cm. (30 ins.) rise, 37 cm. (14½ ins.) thickness at the springs, and 23 cm. (9 in.) at the keys. They are in brick and cement. The bottom is formed of 30 cm. (1 ft.) of concrete and 15 cm. (6 ins.) of brick on edge. The interior linings and the ventilators are like those of the lower reservoir. The division wall across the middle of the reservoir is 1.5 (4.0 ft.) metres thick throughout its entire height. The maximum depth of water is 3.5 metres (11.5 ft).

The influent pipe, after having passed the gate chamber, crosses all the bays of the interior and ends at the opposite longitudinal wall, where it turns upwards by an elbow to the high-water level. The effluent pipe is at the level of the bottom of the reservoir, but a pit 45 cm. (18 ins.) deep is constructed at its inlet in order that it may not draw out any deposits which might have formed on the bottom of the reservoir. The four overflow and drainage pipes unite in a single one of 15 cm. (6 ins.) diameter, which discharges into a rivulet.

PARIS. Among the most notable are the two-story covered reservoirs at Paris. This city derives its water supply from several distinct sources—from the river water of the Seine and the Marne; from the Canal de l'Ourcq; from artesian wells, and from springs. The waters from these different sources vary much in quality, that from artesian wells and springs being the purest. Spring water is brought by the aqueducts of Arcueil and of Belleville, but mainly by the new aqueducts from the upper waters of the Dhuis and the Vanne. The former supplies reservoirs at Menilmontant and Belleville in the easterly part of Paris; the latter supplies the reservoir at Montrouge in the southern part of Paris.

Reservoir of Menilmontant.—This reservoir receives, in two separate parts, the water from the Dhuis and the water from the Marne.* The capacity of the reservoir receiving the water from the Dhuis was fixed at 2.5 times daily discharge of the aqueduct, or at about 100,000 cu. m. (26,400,000 galls.). It was not easy to find a suitable location for so large a structure at Paris. The high land on the right bank of the Seine is underlaid with formations of gypsum, and this material has been so extensively quarried that nearly all the land not built upon is wanting in solidity. After a long search, an undisturbed site was found at Menilmontant, but consisting of the worst material, the green clay of Montmartre. Solid foundations were reached at a depth of 6 or 7 metres (20 to 23 ft.). In order not to be obliged to purchase a separate site for the reservoir to receive the water from the Marne, it was decided to establish this latter in the spaces between the long pillars forming the foundation of the reservoir for the water from the Dhuis, by excavating the clay.

The reservoir of Menilmontant consists consequently of two stories, each of which is divided into two compartments. The two lower compartments, of a capacity of 28,500 cu. m. (7,500,000 galls.), receive the water from the Marne, raised by the pumps at Saint-Maur. Their overflow is at the elevation, 100 metres (328 ft.). The two upper compartments, of a capacity of 100,000 c. m. (26,400,-

*Bulletin de la Société Industrielle de Mulhouse. November, 1887.

* Belgrand. Les travaux souterrains de Paris. V 4.

000 galls.), receive the water from the Dhuis and from the spring of Saint-Maur. This overflow is at the elevation, 108 metres (354.3 ft.). The useful area of the reservoir is 2 hectares (5 acres). Its cost was about 28 francs per cu. m. of useful capacity. It was begun in August, 1863. The water from the Dhuis was introduced into the reservoir in October, 1865, and the water from the Marne in January, 1866. The reservoir was most carefully constructed. Its failure would be attended with disastrous consequences, from its proximity to a dense population.

Some of the more important details of this reservoir are as follows: *

The shape of the upper reservoir is a semicircle united with a rectangle. The diameter of the semicircle, which is 188 metres (617 ft.), forms the long side of the rectangle, whose other dimension is 42.5 metres (139.4 ft.). It is divided into two equal and symmetrical compartments by a division wall, following the radius perpendicular to the long side of the rectangle. The walls of the perimeter have a thickness of 1.4 metres (4.6 ft.) at the top. The interior batter is 1 in 5 for the portion of the wall below the earth. Above the surface the exterior face is vertical. The interior faces are vertical, but are joined with the bottom by an arc 2 metres (6.6 ft.) in radius. The bottom is formed by a system of semicircular groined arches, for the part which covers the reservoir of the Marne, and in segmental groined arches for the other portions. The intrados of these latter rests upon the marl or clay. The arches are of rubble masonry, 35 cm. (14 ins.) thick at the key. The reservoir is covered by groined arches, composed of two courses of bricks laid flat in cement. They rest upon pillars, 60 cm. (2 ft.) square and 6 metres (20 ft.) between centers. These pillars rest upon those forming the foundations of the bottom. The brick arches are about 8 cm. (3¼ ins.) in thickness, including the plastering. They are covered by a layer of earth and turf, 40 cm. (16 ins.) thick. The effluent pipes are 1 metre (39.4 ins.) in diameter, and are so arranged that the supply may be drawn from either compartment or from the aqueduct. This reservoir may be emptied into that of the Marne, and its overflow pipe, which is placed 5 metres (16.4 ft.) above the bottom, also discharges into the latter reservoir.

The reservoir for the water from the Marne occupies only the central portion of the sub-basement of the upper reservoir. Its form is a rectangle, whose larger dimension, parallel with the front, is 104 metres (341 ft.), the other dimensions being 90 metres (295 ft.). It is divided into two equal and symmetrical compartments by the division wall above mentioned. The enclosing walls are placed in the middle, and follow the direction of ranges of arches supporting the upper bottom. They are 1.2 metres (3.9 ft.) thick, with vertical faces; the interior face being joined with the bottom by an arc 2 meters (6.6 ft.) in radius. Their top forms a gallery, which allows free passage around the basins. The bottom follows the natural surface of the gypsum, its thickness being 30 cm. (1 ft.). The pillars which support the arches are 1.25 metres (4.1 ft.) square at the springs and 1.75 metres (5.7 ft.) at the bottom. The influent pipes are arranged to discharge into either or both compartments at pleasure. The effluent pipe is 80 cm. (31.5 in.) in diameter, and is so arranged that the supply may be furnished by either or both compartments. The walls are of rubble masonry. The interior surfaces are plastered with cement mortar.

Reservoir of Belleville.—The reservoir † is situated at a higher elevation than the one at Menilmontant, on the hill at Belleville. It is designed in two stories and four compartments, but only one-half has been constructed. The upper compartment of the capacity of 6,239 cu. m. (1,600,000 galls.) receives the water from the Dhuis. Its overflow is at the elevation 134.40 metres (441 ft.). The lower compartment is supplied by the water of the Marne; its capacity is 11,765 cu. m. (3,100,000 galls.) and its overflow is at the elevation 131.10 metres (430 ft.).

This reservoir occupies a very threatening position. It is entirely above ground and is built upon a steep hill of fine sand. The greatest care was taken in its construction. Standing upon such a foundation, it is exposed to peculiar danger in case of accident, and the consequences of its failure would be incalculable. It was begun in September, 1863, and was finished in December, 1864. Including the residence of the custodians, it costs about 26 francs per cu. m. of useful capacity.

Reservoir of Montrouge.—The capacity of this reservoir is 300,000 cu. m. (79,250,000 galls.) It was constructed on the same system as those at Menilmontant and Belleville, and cost about 20 f. per cu. m. of water stored. It is in two stories, each of which is divided into two compartments. The reservoir is rectangular, and its details are similar to those of the reservoir of Menilmontant. It is supplied with water from the Vanne, and contains about three times the average daily discharge of the aqueduct from that river.

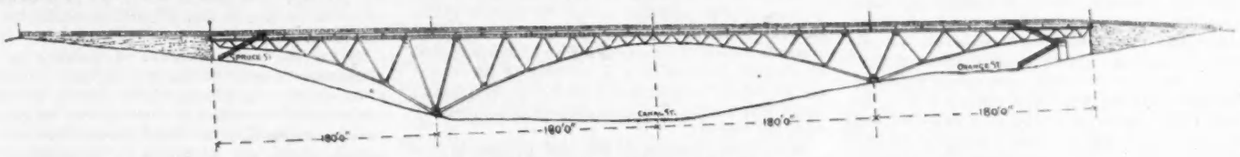
GENERAL CONCLUSIONS.

The question as to the necessity of covering a reservoir must mainly depend upon local requirements and conditions. As a general guide, it may be said that if the supply is from subterranean sources, or if it must be stored after being filtered, a covered reservoir is necessary, and that when a reservoir is amid smoky surroundings, it should be covered. If the supply is from a river or lake, a covering is desirable, if the reservoir must needs be shallow. If the reservoir is deep, of large capacity, and not amid smoky surroundings, the necessity for covering diminishes and the question merges into one of cost. In the case of large storage reservoirs, the expense of covering is generally prohibitory.

The best and most usual method of covering is by arches of masonry or brickwork, coated on the top with asphalt, and covered with 2 or 3 ft. of earth, which may be turfed. Ventilation is important.

* Debauve. Manuel de l'ingénieur des ponts et chaussees fasc: 16.

† Belgrand, loc. cit.



Hawk St. Viaduct, Albany, N. Y.

The Hawk St. Viaduct, Albany, N. Y.

Ever since Albany as a city has been divided by the deep gully which separates Arbor Hill from the Capitoline Hill, and through which run Spruce street, Orange street, and Canal street, at different heights on the gully's sides, the question has been agitated of a bridge across it on the line of Hawk street from Elk street on the south side to Clinton avenue on the north, over all the other three. Such a bridge is now about to be built by the Hilton Bridge Co. of the same city. The plans adopted, which are subject to slight changes in the discretion of the Viaduct Commission, provide for a viaduct of one main arch with a span 500 ft. in length, with two cantilever arms, each 114 ft. long, and each supporting one end of a span 66 ft. long, whose other end rests upon the abutment.

The flooring will be of granite blocks, and the viaduct, according to the specifications, will be of iron and steel, the webs and chords in the arch, cantilevers and supported spans of medium steel; the lateral and sway bracing and the floor beams of iron. The sidewalk will be of asphalt or similar composition. The masonry approaches to the bridge are to be 32 ft. wide, and descending on a grade of 8 ft. in 100. The cost of this structure to the city will be about $90,000 and the work is to be completed within a year.

In 1888 16,300,722 cu. ft. of the lumber were exported from the United States to Havana, Cuba.

Railways in Costa Rica.

The following particulars, which are abstracted from a report by Mr. J. R. WINGFIELD, U. S. Consul at San José, will be of especial interest at the present time, when so much attention is being attracted to this part of Central America.

There are three lines in operation: 1, from the port of Limon, on the Atlantic coast, to Corillo, 70 miles, from which latter place a steep mountain cart road connects with San José, the capital, 28 miles beyond; 2, an interior line from Cartago to San José, Heredia, and Alajuela, total length, 25 miles; 3, from the port of Puntarenas, on the Pacific coast, to Esparta, 12 miles. A line is also under construction from Cartago to Siquires, giving communication between San José and Limon; this road is under contract to be completed by August, 1889, but it is stated that, owing to the many difficulties encountered, it will probably not be completed before August, 1890. The two principal lines in operation, and the one under construction, are owned by the Costa Rica Railway Co., of London, England; the company has also a grant of 800,000 acres of unimproved lands. About a third of the stock of this company is held by the Government. The Puntarenas line is owned and operated by the Government. Mr. WINGFIELD states that in order to preserve the trade with California it is necessary to

The Railway Situation in Costa Rica.

extend this latter line to the interior, as otherwise the completion of the new road will result in nearly all the trade going by way of Limon. He suggests that San Francisco men should acquire the present line and extend it to San José.

Another suggestion is to run a line from Alajuela to the head of navigation on the San Carlos river, about 60 or 70 miles from San José and thus open a connection by the Nicaragua canal with steamers to Atlantic and Pacific ports. It is considered important that a charter for this line should be obtained as soon as possible, as otherwise it will probably be acquired by an English company.

The Laws Governing the Construction and Maintenance of Country Roads in France.

To better understand the following abstract of the laws governing the common or country roads of France, it is necessary to have some knowledge of the administrative divisions of the country, the titles of the subdivisions, and the power and duties of the officers who govern them. In this connection the 204,147 sq. miles of France are somewhat arbitrarily divided into 87 departments, and these departments are subdivided into 362 arrondissements, 2,865 cantons, and about 36,000 communes. Each department is governed by a prefect, appointed by the President of the French Republic; and each arrondissement is administered by a sub-prefect, and each commune by a mayor. The prefects are divided into three classes, and according to the importance of their positions receive salaries of $7,00

$4,800, or $3,600 per annum; the prefect of the Seine, controlling Paris, is an exception to this rule, and he receives a salary of $10,000 per annum.

The authority of each prefect is great in his own department. He can issue local decrees; appoint and dismiss a number of the department officials; he is at the head of the local police, to maintain public order, and can summon the military for this purpose; he superintends the collection of taxes; he transmits the orders and instructions of the general Government to the subordinate functionaries in his department, and is, in fact, the general agent of Government and the chief instrument of centralization in the State. He is assisted by the General Council, elected by the people, and the Council of Prefecture nominated by the head of the executive power. The business of the latter body is to decide all legal questions, and to advise the prefect when asked to do so. The General Council assesses the taxes, authorizes the purchase, sale, or exchange of department property, and superintends its management; it decides about new roads, railways, canals, etc.; votes the budget for sanitary and charitable institutions of the department, and gives advice on all matters of local interest. Political questions were strictly excluded under the old laws; but under the law of 1872, the Council is empowered to immediately assemble, and form a new parliament with their delegates, in case the existing parliament is violently dissolved by a *coup d'état*.

The sub-prefect, with a more limited authority, is the representative of central power in the arrondissement. He is assisted, and to a certain extent controlled, by a Council of Arrondissement, an elective body to which each canton sends one member. Except in this connection the canton, is not an administrative division.

The commune is the administrative unit of France. At its head is a mayor, assisted by deputy mayors, the number of the latter varying with the population. Communes of 2,500 people have one deputy; up to 10,000, they have two; from 10,000 to 30,000, they have three; and one additional for every 20,000 inhabitants above 30,000. The mayor represents both the central power and the commune, with the sometimes consequent trouble of avoiding a conflict of duties. He is the official registrar of births, marriages, and deaths. The mayor and deputy-mayor are not salaried officials. In the large towns they are nominated by the Government; but they must always be chosen from the municipal council which is elected by the people. With regard to the commune the mayor has much the same power and duties as the General Council has in the affairs of a department. Each canton has a commissary of police, who is under the direct control of the mayor, but is appointed by the prefect in towns under 6,000 in population, and by the President of the Republic in all others. The duties of this officer are complex, as he is at the same time a governmental, a judicial, and a municipal agent.

In France, the roads are divided into national, departmental, military, and vicinal or country cross-roads. The national roads are maintained entirely at the expense of the public treasury; the departments provide for the second class of roads and also partly for the military roads; and the local cross roads, or *chemins vicinaux*, are maintained by the communes, or when of higher importance, by the departments. In 1873 there were 223 national roads aggregating 23,180 miles in length, of which 1,632 miles were paved like a street. These roads average in width 52 ft. 6 in. or 16 m., of which 19.68 ft. is for the causeway, 19.68 ft. for the sideways, and 13 12 ft. for the ditches and embankments. The department roads are not quite so wide, their average breadth being 39 ft. In 1872 the aggregate length of the latter was 29,167 miles. The 28 military roads are about 932 miles long in all, and are chiefly in the west of France, laid out after the last insurrection of Vendée. The sum of about $6,800,000 is yearly expended in making new roads or repairing old ones.

The *chemins vicinaux*, or cross-roads, are managed by a special branch of the department of the Minister of the Interior, a branch which employs about 3,000 *agents voyer*, or inspectors, and 42,000 *cantonniers*, or workmen, specially charged with the duty of keeping these roads in repair. In 1872 these cross-roads aggregated 338,273 miles in length and covered a surface of about 915,000 acres. To the very considerable sum which the communes must apply to the extension and repair of these country-roads the Government used to add a yearly grant of $2,300,000; but since 1873 this sum has been reduced to $1,150,000 annually.

(TO BE CONTINUED.)

Aluminium.

Notwithstanding so much has been said in technical journals of late concerning this important metal which appears to have so wonderful an effect in improving the qualities of other metals used in manufacturing, by its alloys, there is still a dearth of information existing in regard to how to obtain the pure metal. No company has yet been formed in this country, it is believed, for extracting the pure metal, although the Cowles Electric Smelting & Aluminium Co., at Lockport, N. Y., are producing the principal alloys by means of the electric smelting process, and the Aluminium, Brass & Bronze Co. are erecting an extensive plant, also for the production and working of the alloys, and expect to be in operation at Bridgeport, Conn., about May 1, 1889. This company obtains its supply from the former.

With the exception of the output of the Aluminium Co., at Oldbury Station, England, the production of pure aluminium is still in the experimental stage, and not yet regarded as firmly established on a commercial basis.

The method of extraction of the pure metal, as carried on in the English establishment, is a combination of Castner's and Webster's processes, the works being situated contingent to Chance Bros.' alkali works, which supply the caustic soda and hydrochloric acid used. The method employed is the production of sodium by Castner's process and of the double chloride of sodium and aluminium, and the reduction from the latter salt of the metallic aluminium by the action of sodium. As this is the only method of obtaining it yet successful on a commercial scale, the following brief account of the process is given, as described in *The Engineer*: The sodium is first produced by the action of a very intimate mixture of carbon and iron, obtained by coking a mixture of pitch and finely divided iron upon melted caustic soda at a strong red heat. It is performed in large steel crucibles attached to the head of a hydraulic plunger which are pressed against a fixed arc and delivering pipe, the arrangement forming a kind of still, which is heated by gas from a Wilson producer running with heated air. The action of the iron is merely to ballast the carbon and prevent it floating to the surface of the melted alkali, the active reducing agent being the carbon. About one-third the alkali is reduced, and distils over into a tubular receiver connected with a cylindrical pot filled with naphtha, which holds the condensed melted sodium. The remaining alkali becomes carbonized and is converted into a solution of carbonate of soda, which is pumped back to the alkali works to be reconverted into caustic. The pots now used are 18 ins. diameter by 2 ft. high, and contain about 80 lbs. of materials. As often as the distributing process is finished, the pots are removed and emptied, and again filled with a new charge without allowing them to cool. By this means the time required for a charge has been reduced from 2½ to 1½ hours. Each pot furnishes 14 lbs. of sodium, and there are 4 furnaces, each having 5 reducing pots, which gives a capacity of about 1,500 lbs. of sodium per day.

To handle the sodium it is melted in heated petroleum and cast into rectangular bars, one foot long, which are packed in petroleum tins filled and sealed, and for transportation these are inclosed in a second tin partly filled with lime and petroleum, which apparently acts to preserve the metal from oxidation.

The next operation is the preparation of aluminium chloride by the slow action of gaseous chlorine upon a mixture of alumina and carbon strongly heated in retorts. As nearly pure alumina is obtained as possible and mixed and dried with lampblack. The chloridizing furnaces are similar to small open-hearth regenerative steel furnaces, and contain 5 D-shape clay retorts, which are charged from one end, the other end being connected with a condenser. The chlorine is fed through a tube on the charging side.

The chlorine is made in stone stills from manganese ore and hydrochloric acid, in the usual manner, and conducted through a main from the Chance alkali works. Gas is supplied to the retorts from gasometers, and the quantity controlled by a hydraulic regulator adjusted by a cock to deliver the quantity required. The charge in the retort requires two to three days time to work it off, and the working capacity of the 12 furnaces is about 6,000 lbs. per day.

The mixed double chloride of sodium and aluminium contains about 12 per cent. of aluminium and is reduced by heating it with sodium and cryolite, the proportions being 80 lbs. of the double chloride to 25 lbs. sodium and 30 lbs. cryolite. This mixture is ground to a fine powder and gives 8 lbs. of metallic aluminium, which is about 98 per cent. pure metal, the rest being mainly iron and silicon. The maximum production of these works is about 500 lbs. per day. The present cost of the pure metal is about $5 per pound, and difficult to obtain even at this price.

By far the easier method of making use of aluminium is by obtaining it as an alloy by means of the electric smelting process. Besides the companies above mentioned, in this country, the French have for a long time produced these alloys, and extensive plants are employed in Switzerland, at Lauffen-Newhausen and Schaffhausen. The latter works produce them in large quantities by the Hérault patent method, which consists in fusing the refractory earths containing aluminium by the electric current.

The effect of even very small quantities of aluminium alloyed with other metals is very remarkable.

Added to copper, the compound has the strength of steel. Ferro-aluminium, added in small quantities to steel, insures clear and limpid castings. Added to cast-iron, it not only increases greatly its transverse strength and diminishes the shrinkage, but causes the castings to be free from blow holes and chills. One per cent. of aluminium, in some manufactured iron articles, doubles the value of the iron in price per ton.

Present list prices of some of the more important alloys, with tensile strength, etc., are as follows:

	Tensile strength.	Elongation.	Price.
Al. bronze.....	90,000 lbs. to 24,000 "	0 to 5 % 20 "	$0.55 .26
Al. brass.....	60 000 " to 30,000 "	10 to 25 " 20 to 30 "	.32 .27
Al. silver	70,000 " to 100,000 "	5 to 10 "	.75

Al. iron (ferro-aluminium) at $5 per lb. for the contained metallic aluminium and 1½ cts. per lb. for the iron.

Aluminium bronze has been already quite extensively used for light and heavy guns, torpedoes, steam hammers, propeller wheels, and for the wearing parts of machinery. Gear wheels, agricultural machinery, boating hardware, and in sheet metal form, gas burners, etc., have been made from it. The aluminium brass is used for chains, in the construction of dynamos; and the uses of the various alloys are continually increasing in number and variety, as their useful qualities appear to be needed in almost endless applications in the metal manufactures.

THE UNITED STATES DEBT statement for the month of January shows a total debt, principal and interest amounting to $1,685,308,059, against which is held a reserve, available cash items and net cash, amounting to $563,462,087. Deducting these items, there remained a total net debt on February 1, of $1,121,845,972.

AN ELECTRIC TRAVELING CRANE has been erected in the foundry of E. P. Allis & Co., Milwaukee, Wis. It weighs about 30 tons and can lift and carry 25 tons. The crane is a trussed beam moving on overhead rails and is provided with three electric motors—one to move the crane, another to move the carriage on the crane, and a third to do the lifting. It is claimed to be economical in power and wear and tear of machinery. Another electric crane with one motor, is said to be in use in an English foundry.

The Practical Calculation of the Heads, Diameters, and Discharges of Long Pipes.

BY E. SHERMAN GOULD.

[The present paper is an attempt to solve, in a practical way, the problems connected with the flow of water through long pipes, to make the results more directly applicable to the complicated conditions under which such problems frequently occur in practice than is the case with the most nearly corresponding problems in existing text-books.

These problems, of which it is believed that solutions cannot be found readily, if at all, in works now in the hands of the profession, are nevertheless liable to frequently present themselves in the designing of important systems of water supply. It is hoped, therefore, that the following pages may aidthe hydraulic engineers somewhat in dealing with such problems in a scientific way.—E. S. G.].

Let us suppose a reservoir of large relative area and capacity to be tapped near its bottom by a horizontal cylindrical pipe, of which the length is equal to about three times its diameter.

If there were no physical resistance to the flow, the velocity of the water issuing from the pipe would be given by the formula for the velocity of falling bodies:

$$V = \sqrt{2gH} = 8.02\sqrt{H}$$

in which V = velocity in feet per second, g = the acceleration due to gravity = 32.2 ft., and H = the height, expressed in feet, of the surface of the water in the reservoir above the center of the pipe.

Observation shows, however, that in the case cited the velocity of discharge is equal only to that theoretically due to a height of about two-thirds of H, that is:

$$V = \sqrt{\frac{4gH}{3}} = 6.55\sqrt{H}.$$

The remaining third of the height is consumed in overcoming the resistance offered to entry by the edges of the orifice to the inflowing vein of water. The head necessary to overcome the resistance to entry is, therefore, about one-half of that necessary to produce the velocity of flow.

If the length of the pipe should be increased progressively and indefinitely, the velocity would be found to diminish inversely as the square root of the length. It would correspond, therefore, to a smaller and smaller percentage of the total head H. The resistance to entry diminishes directly as the velocity, and the head necessary to overcome it is always equal to about one-half of that necessary to produce the given velocity as calculated by the laws of falling bodies.

As the length of the pipe (always supposed to remain horizontal) increases, and the velocity of discharge diminishes, the sum of these two heads, *i. e.*, one and a half times that necessary to produce the actual velocity, is no longer equal to the total head H, as we have seen to be the case when the length of the pipe is only about three diameters. What then becomes of the remainder of H? It is consumed in overcoming the frictional resistances engendered by contact of the moving water with the inside surface of the pipe. When the pipe is very long, and the velocity therefore relatively low, the sum of the velocity and entrance heads is small, and by far the greater part of the total head is required to force the water through the pipe against the opposition offered to its flow. In such cases, which are those occurring most generally in practice when water is conveyed from a reservoir for the supply of a town, the velocity and entrance heads are commonly ignored, and the total head H is supposed to be available for overcoming the frictional resistances. As this occasions, however, an error—although generally a very small one—in the *wrong direction*, judgment is required in exercising this latitude. Later on we will revert to this point, but for the present, we will consider only frictional resistances, particularly since—and indeed because—in practice our assumed data are almost always sufficient to afford an ample margin to cover the neglected factors.

In what precedes we have considered a horizontal pipe issuing from a reservoir in which the surface of the water is maintained at a constant level. In practice these conditions rarely obtain.

Suppose a system such as is shown by Fig. 1, consisting of a reservoir and pipe line of varying and contrary slopes. As the level of the water in the reservoir would be subject to fluctuations, and liable at times to be greatly drawn down, it is customary to consider the surface of the water as standing at its lowest possible level, *i. e.*, the mouth of the pipe. In this case, the value of H would be equal to the difference of level of the two extremities of a and b of the pipe, and the line $a\,b$ joining the centers of the two ends would form what is called *the hydraulic grade line*, the establishing of which is the first step to be taken in laying out a system of water supply.

Suppose that at the points c, d, and e vertical tubes, open at their upper ends, were connected with the pipe. The water, when flowing freely from the end b of the pipe, would rise in each of these tubes to about the height of the hydraulic grade line at these points, and if branches were connected at the points c, d, and e, they would, when closed, sustain a static pressure upon their gates equal to the head comprised between the gates and the grade line. If the gates were open, the branches would discharge water under heads equal to the difference of level of the hydraulic grade line at the point of embranchment and their remote extremities, less a certain amount depending upon the volume discharged, which will be spoken of hereafter.

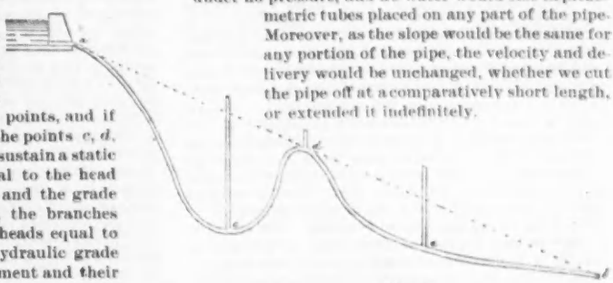


Fig. 1.

At d, where the top of the pipe just touches the grade line, there would be no pressure at all when the water was flowing through the pipe, except the very small amount due to the depth of water in the pipe itself.

If the end b should be closed so that there was no movement of water in the pipe, the water would rise in the tubes, if they were long enough, until it stood at the same level as the water in the reservoir, and the pressures at c, d, and e would be equal to the head comprised between these points and the level of the water in the reservoir. This latter is called the *hydrostatic pressure*, or simply the *static pressure*, and the former *hydraulic pressure*, at these points.

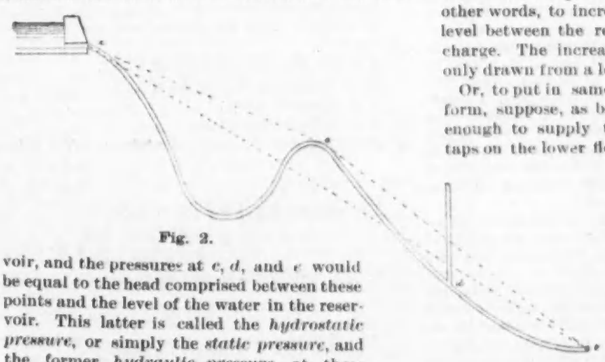


Fig. 2.

The tubes spoken of are known by the name of *piezometric tubes*.

The importance of correctly establishing the hydraulic grade line is illustrated by reference to a case such as is shown in Fig. 2, in which the pipe, at the point c, rises above the grade line $a\,b$. To explain: It will be readily deduced from what has been already said in reference to horizontal pipes that the velocity of flow, and consequently the delivery, of a pipe increased with the steepness of its slope. In this case the pipe $a\,b$ is divided into two parts, the one $a\,c$ with a hydraulic grade line flatter than $a\,b$, and the other $c\,b$ with one steeper than $a\,b$. The delivering of the entire system, if the pipe were of the same diameter throughout, would be governed by the flatter portion $a\,c$, and the portion $c\,b$ would be capable, in virtue of its steeper slope, of discharging a greater volume of water than it could receive from $a\,c$. Consequently it would act merely as a trough and would never run full, and if a piezometric tube were placed in it at d, for instance, no water would rise in the tube, and no pressure be exerted.

It is very important, therefore, in locating a pipe line that the pipe should nowhere rise above the hydraulic grade line. The full amount of water could indeed be carried over the high point c by means of syphonage, but this expedient is not resorted to in practice. Should the nature of the ground require such a location as that shown in Fig. 2, it would be necessary to increase the diameter of the pipe between a and c, so that it would deliver the required volume under the reduced head, and to diminish that between c and b, so that it should only deliver the same volume under its increased head, and therefore run full. The calculations necessary to determine the proper diameters will be shortly developed.

Should the axis of the pipe coincide exactly with the hydraulic grade line ab, the pipe would run full (provided the feed were sufficient) but would be under no pressure, and no water would rise in piezometric tubes placed on any part of the pipe. Moreover, as the slope would be the same for any portion of the pipe, the velocity and delivery would be unchanged, whether we cut the pipe off at a comparatively short length, or extended it indefinitely.

As a further and very interesting practical illustration of the effects of a hydraulic grade line of varying steepness, let us consider (Fig. 3) the case of a house supplied with water by a pipe communicating with a reservoir.

Suppose the pipe to be just sufficiently large to furnish a certain volume of water per hour to the upper story of the house. If now a larger volume were required, it is clear that, unless we increase the diameter of the pipe, it would be necessary to increase the steepness of pitch of the grade line, in other words, to increase the head, or difference of level between the reservoir and the point of discharge. The increased volume could therefore be only drawn from a lower story.

Or, to put in same conditions under a different form, suppose, as before, the pipe to be just large enough to supply the top story of the house, the taps on the lower floors being closed. Should they be opened, it is evident that a greater amount of water would be discharged from them than from the upper one, because they would discharge under a greater head. The result would be a diminished flow, or perhaps no flow at all, on the top floor, and an increased discharge of water at a lower level.

This case shows why the water ceases to rise in the upper stories of the houses of a town when the consumption increases.

It has been found by observation that the velocity of water flowing through pipes is greatly affected by the nature of their inside surface, increasing with the smoothness and diminishing with the roughness of the same. By direct experiment, coefficients have been established for different conditions of surface. It has also been found that these coefficients vary slightly with the diameter of the pipe, a pipe of a certain size giving a greater velocity than one of the same character of inside surface but of smaller diameter, the differences becoming smaller as the diameters increase.

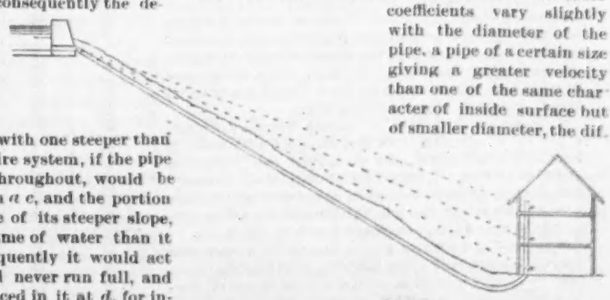


Fig. 3.

The value of this coefficient, which will be designated throughout this paper by C, is given below for a number of different diameters and for two classes of pipes,—those which are clean and smooth on the inside, and those which are rough and incrusted, the difference being as 2 to 1. As all pipes, after a few years of service, are liable to become more or less roughened and obstructed by deposits, it is always safer when calculating the proper dia

meters of a permanent water supply, to assume rough pipes at once, although diameters thus calculated will, for perhaps a number of years, deliver quantities greatly in excess of the desired amounts.

(TO BE CONTINUED.)

Cylindrical Wheels and Flat-Topped Rails.

(*Continued from page* 118.)

When the subject of rails was under discussion at our last annual convention, our past President, J. B. FRANCIS, gave us the key to the solution of the problem, and this was, that the material composing wheels and rails should not be subjected to pressures beyond their elastic limit. It is now over a dozen years since, in an evening's discussion with the late lamented C. SHALER SMITH, we had under consideration the subject of elasticity; the result of my calculations was, that driving wheels of locomotives, as then loaded, must have a diameter of about 17 ft., to keep the contact between them and the rail within the elastic limit. Calculations since made, convince me that this was an under-estimate.

It is hardly necessary for me to direct your attention to the following sketch as illustrating our practice, as shown in Fig. 1. The author's proposed arrangement is shown in Fig. 2 without, however, endorsing the section of rail shown below the line "A B." [These engravings were published last week.—ED.]

As children, we listened with interest to the story of the genius shown in the invention of the coned wheel for railway purposes, and were taught that, without it, curved lines could not be operated, etc. What are the facts? A new wheel, constructed in accordance with the rules of the Master Car Builders' Association, is coned to suit a curve of about 5,000 ft. radius, and no other; and after six months' use, as shown by the preliminary report of your Committee, such wheels are either worn hollow at the flange or from the flange; so much so that in at least one-third the instances in passing curves, the inner wheel travels on its greatest diameter, and quite often the outer wheel travels on its least diameter. Yet such wheels are operated safely. The German investigator, KRUGER (see Vol. 86, Inst. C. E.) proves by analysis what is apparent to all of us, that rolling friction is largely augmented through this device. I understand that the Association of Master Car Builders, at its meeting some two years ago, decided, by a majority of three of the members in attendance at its convention, to continue this practice, but that a large majority of those eminently practical men who were not in attendance were vigorously opposed to it.

The form of rail shown in Fig. 1 is that lately recommended by SANDBERG for a 100-lb. rail, has a curved top of 6 ins. radius, and from the sketch it is seen that in so far as the elasticity of wheel and rail will permit, it is about the best arrangement that can be devised to concentrate the stress on a point and have the travel of the wheel on a line. These are conditions that are revolting in a mechanical light, conditions we would hardly attempt to reproduce in any other mechanical device. While this condition prevails with new car wheels, engine drivers are generally turned cylindrical, and the work done by them and the car wheel tends to drive down this arch of the rail as a wedge, and by flow of metal to make it flatter, at the same time producing characteristic curves of wear on the wheels, often resulting in shattering and piping the railheads with but little loss of material from direct wear. This flattening of the rail from an original radius of 10 or 12 ins. to over 14 ins. is well illustrated in the report of your Committee.

Mr. OCTAVE CHANUTE, member of the American Society of Civil Engineers, many years ago gave us the results of his measurements of the area of contact between wheels and rails, and the writer quite recently made measurements in a similar manner, the results of which it may be proper to reproduce here. However crude the manner of taking the impressions may have been, I know of no other convenient way of securing them.

My first test was with an engine having 4 driving, wheels, each carrying 16,000 lbs; diameter of wheels, 70 ins.; tires much worn, and on a steel rail 5 years in constant service. A composite picture of all these apparent areas of contact shows an egg-shaped oval, having a major axis across the rail of 1.48 ins. and a minor axis along the rail of 1 in., enclosing an area of 1.07 sq. ins.

My second test with an engine having 6 driving-wheels of 62 ins. diameter, carrying 13,800 lbs., with tires that have been in service 6 months, gave a similar figure of contact, with a major axis of 1.27 ins., and a minor axis of 0.79-in., enclosing an area of 0.86 sq. in. Through such contacts is transmitted the power exerted by our locomotives, not only in their direct compressive force, but also in their pulling capacity of say 4,000 lbs. on the lamina of the rail. Is this the one spot in our earthly domain to which we cannot apply reason? The ingenuity of man has been able to formulate the approximate horse-power of the earthquake, finding the factors in shattered towers and dismantled homes: must that ingenuity stand appalled before this point of contact between wheel and rail? If so, we should exclaim with more effectiveness than did Lady Macbeth, "Out, damned spot!"

It is on this spot, where, if the statement made in a paper now before this Society is construed literally, occurs that miraculous chemical action, "the molecular interlocking of the fibers" of a non-fibrous substance; but I suppose we all know the meaning intended by this sentence.

To me, and doubtless to many of our members outside of some of your Committee, the solution of this problem rests in having a flat and sufficiently broad surface to the rail to support, not conical, but cylindrical wheels, to keep the pressures within the elastic limit of the metal. Right here we are met by the statement, in a paper now before us, that it is not clear that "increased bearing surface is in itself an advantage;" and when we attempt anything like an analytical inquiry, we are met by *ex cathedra* statements contained in the same paper "that to such bearing surfaces the ordinary compression module of the text-books has no application whatever. . . . To apply these constants to the bearing surfaces of spheres or cylinders laid on their sides, or to draw conclusions that pressures exceeding them are therefore dangerous or destructive, is entirely unwarranted. No attempt has ever been made, nor can there well be, to determine constants for such round bodies, etc., and in good bridge practice it is considered entirely safe to load steel rollers rolling on steel up to the equivalent of 10,000 lbs. per linear inch for a 33-in. wheel."

I heartily wish that all abstruse questions in engineering were as well settled in the minds of engineers as these appear to be in the minds of some of your Committee. Ordinarily it is time wasted to attempt an argument before a jury that has already rendered its verdict on the important questions at issue, and I trust that this Committee will pardon me if I overcome my natural modesty, and appeal to those of our members present whose minds are open to conviction, to exercise patience while I call their attention to the labors, text book, and formula of one more astute than the celebrated character in Hudibras,

> "Who could distinguish and divide
> A hair 'twixt south and southwest side,
> And wisely tell what hour o' the day
> The clock does strike, by algebra."

I mean Prof. FREDERICK GRASHOF, of the Polytechnic School at Carlsruhe, one of whose formulæ has been extensively used in this country for determining constants for rollers on plane surfaces in nearly every first-class bridge specification for many years, and heretofore referred to by our Member, Mr. CHARLES MACDONALD, with telling effect, in his criticism of C. SHALER SMITH'S paper on drawbridges, published in our Transactions as long ago as 1874, and in the same volume containing the report on rails made by our lamented past President, ASHBEL WELCH, as chairman, in which report is repeated six or eight times the necessity of securing greater width of contact between wheel and rail. In making use of these formulæ in constructing the following table, the moduli were assumed by me at the values stated, after an examination of the tests made by our Member, Mr. CHRISTIE, and reported in our Transactions some years ago. It will be seen in the table of tests of steel in rails of the C. B. & Q. Ry. that the modulus of resistance is somewhat lower than I have assumed in some instances, and much greater in others. I have utterly failed in my attempt to secure data relating to the moduli of chilled cast-iron; hence you will consider the results of my calculations in this table as applying to steel wheels on steel rails. The table is not given as a play upon figures, but as an educator of the judgment. It has had that effect with me, and I trust it will not be without interest to others who have not given this subject their particular attention. [This table was published last week.—ED.]

Table showing allowable Pressures of Wheels on Rails with Curved Tops, also on Rails with Flat Top Surface.

Assuming different values of K and in which formulæ,

K = elastic limit per square inch, and such portion thereof as may be deemed safe. Designated K_1 K_2 K_3 K_4.

E = modulus of elasticity of wheel.

E_1 = modulus of elasticity of rail.

R = radius of wheel.

R_1 = radius of rail-top.

P = allowable pressure of wheel on rail. For rails with curved top the formula is

$$P = \pi \left(\frac{1}{E} + \frac{1}{E_1}\right) K^2 \sqrt{R R_1}$$

For rails with flat top the formula is

$$P = \sqrt{\frac{32}{9}\left(\frac{1}{E} + \frac{1}{E_1}\right)} K^2 R = \text{pressure per linear unit of tread.}$$

In this table the assumed modulus of wheel tread is 29,000,000 and for the rail 30,000,000.

Radii of wheel and head of rail.		Weight on wheels according to recent practice.	Assuming the value of K as stated the weight on wheels can be as follows:				
Wheel	Rail.		K = 40,000	K_1 = 35000	K_2 = 30000	K_3 = 25000	K_4 = 20000
ins.	ins.						
35	8		5722	4967	3212	2225	1422
35	10		6398	4882	3591	2488	1590
35	12		7008	5348	3934	2725	1741
35	14		7570	5777	4250	2944	1881
35	16		8093	6176	4543	3147	2011
35	18		8584	6515	4819	3338	2133
30	8		5298	4043	2974	2060	1316
30	10		5923	4520	3325	2308	1472
30	12		6489	4952	3643	2523	1612
30	14		7008	5348	3934	2725	1741
30	16	From 12000 to 16000	7492	5718	4206	2913	1862
30	18	lbs. and in some instances 20000 lbs.	7947	6065	4461	3090	1975
27	8		5026	3835	2821	1954	1249
27	10		5619	4288	3154	2185	1396
27	12		6156	4698	3456	2394	1530
27	14		6649	5074	3732	2585	1652
27	16		7108	5424	3990	2764	1766
27	18		7539	5753	4232	2931	1873
24	8		4738	3616	2660	1842	1177
24	10		5298	4043	2974	2060	1316
24	12		5804	4429	3258	2257	1442
24	14		6268	4784	3519	2437	1558
24	16		6701	5114	3762	2606	1665
24	18		7108	5424	3990	2764	1766
21	8		4432	3382	2488	1723	1101
21	10		4955	3782	2782	1927	1231
21	12	Sleeping and dining	5429	4146	3048	2111	1349
21	14	cars 6000 to 6500 lbs.	5863	4475	3292	2280	1457
21	16		6268	4784	3519	2437	1558
21	18		6649	5074	3732	2585	1652
16½	8	Passenger and sleep-	3929	2998	2205	1528	976
16½	10	ing cars, 5500 to 6500	4392	3352	2466	1708	1091
16½	12	lbs. Freight cars from	4812	3672	2701	1871	1196
16½	14	3000 to 11500 lbs. and	5198	3966	2918	2021	1291
16½	16	for rotary snow	5556	4240	3119	2160	1381
16½	18	plows 16000 lbs.	5894	4498	3308	2292	1464
35	Flat top		23243	19025	15097	11482	8134
30	"		21519	17614	14086	10630	7530
27	"		20415	16710	13360	10085	7144
24	"		19248	15755	12502	9508	6736
21	"		18006	14738	11695	8895	6301
16½	"		15959	13063	10366	7884	5585

These formulæ for the values of K K_1 K_2 K_3 and K_4 can be reduced to expressions as follows, viz:

Elastic Limit.	For Cylinder on Cylinder.	For Cylinder on Flat Track
$K = 40{,}000$	$P = 342\sqrt{R R_1}$	$P = 3{,}929\sqrt{R}$
$K_1 = 35{,}000$	$P = 261$ "	$R' = 3{,}216$ "
$K_2 = 30{,}000$	$P = 192$ "	$P = 2{,}552$ "
$K_3 = 25{,}000$	$P = 133$ "	$P = 1{,}941$ "
$K_4 = 20{,}000$	$P = 85$ "	$P = 1{,}375$ "

The formula I wish to call your attention to first, is that which applies to cylinders and rails having their axes transversely to each other, precisely the conditions which prevails with wheels and rails. It may be claimed that the moduli of elasticity assumed are not correct. My answer is, assume any other within reason, and then deduce results. It is true that these formulæ apply to the cylinder or wheel, but in degree they apply with equal force to the rail; or, to put it in the language of a late editorial in ENGINEERING NEWS on this question: "It is a fair presumption that whatever wears the rail most, wears the wheel most."

No words of mine are needed to give weight to the deduction that can be drawn from this table. Of course it is nonsense to contemplate the use of driving wheels of 30 ft. and over in diameter to keep within the elastic limit of rails having a rounded head of 12 ins. radius. Note what results are given for wheels on flat surfaces. Please bear in mind that these figures apply only to static conditions of loads; what should be the practice when we add that indefinite quantity due to momentum or impact, imperfect wheels and track, and unbalanced locomotive at high speeds? Our wonder is, not that rails fail so soon, but they last so long!

Mr. WHITTEMORE then claims that this table at once suggests the remedy: which is, that without the necessity of increasing the diameter of the wheels, we should provide a contact between wheel and a flat surface of rail of from 2¼ to 2½ ins. wide, taking for his factor of safety that given in the use of the value of K_3 above, although he regards that derived from K_4 as corresponding more nearly with bridge practice; and continues:

It is true, as reported by your Committee, that our rails fail with little material abraded from the top. The fact is, they are crushed, after flow of metal has reached its limit; they fail like, all other crystalline substances when over-taxed, by rapid disintegration and not abrasion, and it is the exception to find in the scrap-heap a rail with the head well worn down.

If my premises are correct, that a wider bearing surface is necessary, the question naturally arises. Can such forms be rolled? A way is always found to do that which must be done; but if this width of rail-head shall prevail, then the indications are that the SANDBERG pattern of T rail—with its sacrifice of from 1 to 2 lbs. per yd. in reenforcing the two cantilevers of its head to accommodate splice-bars that in themselves restore the rail to only one-half of its strength as a girder, where intact—must be a thing of the past.

(TO BE CONTINUED.)

Cement Lined Water Pipe.

A joint special committee of the City Councils of Springfield, Mass., has been chosen to investigate the problem of how best and most economically to lay a new main from Ludlow to obtain an increased water supply. A 24-in. cast-iron main would cost $225,000, which might be laid to connect with the existing 24-in. cement-lined main. In discussing the question of cast-iron vs. cement-lined pipe, the committee sent to 50 cities and towns a series of question relating to durability, etc., of cement-lined pipe, and whether or not such pipe was being replaced by cast-iron. Forty replies were received, and the majority stated that the use of the lined-pipe was in disfavor, and that it was being rapidly replaced by cast-iron. Brooklyn had used cement-pipe between 1859 and 1884, but had given it up as unserviceable. Chelsea, Mass., used some such pipe 21 years, and its condition is fairly good; but cast-iron was found to be more reliable and economical. Worcester had a little of this pipe in use for 12 to 16 years; but the condition is poor, owing to frequent leaks. Hartford, Conn., has 12 miles of cement pipe and has used it 25 years; but it has been given up as causing much trouble from breaks. Fitchburg, Mass., used such pipe between 14 and 17 years; but has given it up as a matter of safety, and because the repairs cost more than the change to cast-iron. Concord, N. H., has cement pipe laid for 16 years, and as it is in good condition, still adheres to it. Brockton reports cement pipe as all right and no leaks.

In Pittsfield the water commissioners say that cement pipe has been used since 1855, and its condition is good as far as they know. New Bedford officials consider the pipe unreliable. In New Haven the pipe is considered reliable and no change is contemplated. Meriden, however, sings a different tune. There the cement pipe has been used since 1869 and its condition is very poor. It cannot stand a pressure of more than 100 lbs. Woburn considers that its condition is perfect with a pressure of between 60 and 95 lbs. It has used the pipe 15 years and does not contemplate a change. Manchester, N. H., has the pipe laid 15 years ago, but does not want any more because it bursts. The pipe in Salem has been laid 20 years and is considered good, so they are not substituting iron pipe. Cambridge has not laid any for 15 years, and is substituting iron because there is no doubt of its advantages. New London has laid no cement pipe since 1872, and the commissioner says, "I would on no account lay a large main of cement-lined pipe, and small mains with only those of the best workmanship and material." Providence considers the pipe treacherous. Experience in Somerville shows that the pipe bursts, there being an average of 80 breaks a year. Portland after 20 years' experience has taken all the pipe up because it could not stand the pressure. In Waltham the pipe has been used since 1873, but as it is beginning to rust, no more cement pipe will be laid. Boston has little of this kind of pipe. It is found to rust and burst. Malden has some laid 20 years ago and is substituting iron pipe.

The answers to the questions as to the amount of water used per capita, and the annual receipts, were not given in all the slips returned. Those which were given, however, are interesting to compare with Springfield's rate per capita per day of 100 galls., and her receipts of $129,464 last year. The other cities are as follows:—

Gallons used per capita—Holyoke, 71; Fitchburg, 60; Taunton, 32; Lawrence, 68; Cambridge, 50; Albany, 100; Hudson, 148; South Framingham, 40; New London, 99; New Bedford, 85; New Haven, 112; Meriden, 50; Woburn, 60; Manchester, N. H., 45; Brooklyn, 66; Jersey City, 100; Chelsea, 60; Worcester, 50; Hartford, 50; Providence, 44; Syracuse, 80; Troy, 130; Lowell, 65; Portland, 150; Waltham, 30; Boston, 80; Malden, 65.

Annual receipts from water rents—Northampton, $22,364; Fitchburg, $51,000; Taunton, $39,444; Concord, N. H., $38,441; Newark, N. J., $240,000; Utica, $70,000; Brockton, $26,000; Pittsfield, $25,000; New Bedford, $51,000; New Haven, $210,000; Meriden, $50,000; Woburn, $28,118; Manchester, $80,000; Lawrence, $80,554; Salem, $52,000; Cambridge, $214,000; Albany, $255,900; South Framingham, $12,000; New London, $23,575; Jersey City, $539,227; Chelsea, $70,000; Worcester, $130,000; Hartford, $145,000; Waltham, $41,127; Boston, $1,540,000; Holyoke, $58,954; Malden, $59,877; Providence, $346,731; Syracuse, $77,000; Lowell, $180,000; Somerville, $90,000.

The Thurlow Cast-Steel Gun.

After the disastrous failure of the Bessemer steel gun, there were some natural misgivings as to the results of the test of the open-hearth cast-steel gun made by the Standard Steel Casting Co., of Thurlow, Pa. But the Annapolis trial of Feb. 7 has dispelled this doubt as far as ten full-service rounds fired within 20 minutes could prove the efficiency of this new weapon.

The original casting was made at the works at Thurlow 10 months ago, with 13 tons of open-hearth steel used in the cast. It was rough-turned and bored out at Thurlow, and turned, rifled, and polished at the Washington Navy Yard. The walls at the breech are 7¼ ins. thick, at the muzzle, are 2½ ins. thick. The total length of the gun is 193¾ ins. The tensile strength of the metal is 80,000 lbs. the elongation 21 per cent., the reduction 19 per cent., the elastic limit 40,000 lbs. With a charge of 48¼ lbs. of brown, prismatic powder, a conical shell weighing 100 lbs. has a muzzle velocity of 2,000 ft. per second.

The 2 preliminary 36-lb. charges and the 10 48-lb. service charges, with a 100-lb. projectile in each case, were fired within 33 minutes. The Stargauge tests for expansion have not yet been made public.

The one thing established is that a cast-steel gun can be made to stand the Government test of 10 service rounds—a gun that costs only $5,300 and has a calculated range of 9 miles. Mr. BALDT, the manager of the Standard Steel Casting Co., claims that they can make a better gun still; and that, even if the present gun is for any reason rejected by the Government, this fact will not deter them from making another and better gun. Mr. BALDT says that this gun was not tempered, and when it was cast it took every bit of steel they could scrape up about their works. Experiments made with 3 test-pieces taken from this gun showed that by oil-tempering, the elastic limit was increased from 40,000 to 77,000 lbs., and the tensile strength from 80,000 to 109,000 lbs. This gun had 21 per cent. of elongation, but when oil-tempered this was reduced to 9 per cent. The metal can also be increased in density by giving it a greater casting-head. Existing facilities are ample at the works of the company to turn out 10 such guns per week, if called for.

Estimate of Values of Foreign Coins.*

Country.	*Standard.*	*Monetary Unit.*	*Par of Exchange or equiv. value in terms of U.S. gold dollar.*
Argentine Rep.	Double	Peso	$0.965
Austria	Single silver	Florin	.345
Belgium	Double	Franc	.193
Bolivia	Single silver	Boliviano	.699
Brazil	Single gold	Milreis of 1,000 reis	.546
British Poss'ns, N.A.	Single gold	Dollar	1.00
Chili	Double	Peso	.912
Cuba	Double	Peso	.926
Denmark	Single gold	Crown	.268
Ecuador	Single silver	Sucre	.699
Egypt	Single gold	Pound (100 piasters)	4.943
France	Double	Franc	.193
German Empire	Single gold	Mark	.238
Great Britain	Single gold	Pound sterling	4.866½
Greece	Double	Drachma	.193
Guatemala	Single silver	Peso	.699
Hayti	Double	Gourde	.965
Honduras	Single silver	Peso	.699
India	Single silver	Rupee of 16 annas	.332
Italy	Double	Lira	.193
Japan	Double	Yen {Gold / Silver}	.753
Liberia	Single gold	Dollar	1.00
Mexico	Single silver	Dollar	.759
Netherlands	Double	Florin	.402
Nicaragua	Single silver	Peso	.699
Norway	Single gold	Crown	.268
Peru	Single silver	Sol	.699
Portugal	Single gold	Milreis of 1,000 reis	1.08
Russia	Single silver	Rouble of 100 copecks	.559
Spain	Double	Peseta of 100 centimas	.193
Sweden	Single gold	Crown	.268
Switzerland	Double	Franc	.193
Tripoli	Single silver	Mahbub of 20 piasters	.63
Turkey	Single gold	Piaster	.044
U. S. of Colombia	Single silver	Peso	.699
Venezuela	Single silver	Bolivar	.14

* From the report of the Director of the Mint.

THE BIRMINGHAM SEWAGE FARM.—In a communication to the *Gesundheits Ingenieur*, Mr. CHARLES HANCOCK, F. S. S., describes the sewage farm at Saltley, Birmingham. This farm has a total area of 1,227 acres, of which 888 are freehold, the remainder leasehold. The area of the district drained is 47,275 acres, with a population (1885) of 619,698, and a ratable value of £2,401,093. The dry weather flow of the sewage is on an average 16,000,000 galls. daily, and it reaches the farm through three sewers, the largest of which is 6 ft. 6 ins. high by 9 ft. wide. For the purpose of precipitation, about 11 tons of lime are used daily, the machinery being kept in motion during the whole 24 hours. The lime after slaking is conveyed to the upper story of the lime shed, where it is poured into a large vessel resembling a brewer's mashtub, where it comes in contact with part of the sewage, which is pumped in on the other side of the vessel. The lime is ground up here by two revolving stones, and the compound of sewage and lime, which has now been converted into milk of lime, is run into the "roughing" tanks, where the grosser impurities are precipitated. There are 3 large tanks and 16 smaller ones at the farm, with a total capacity of 1,169,360 cu. ft. From these tanks the sludge is raised by an endless chain of dredger-buckets and removed to beds prepared for it in other parts of the farm. The sludge is allowed to remain on the surface for 14 days, and is then dug into the ground, on which various crops are grown with great success. The liquid, after the separation of the sludge, is also passed into the land and percolates through it into drains, from which it issues finally as a clear and odorless effluent.—*Engineering.*

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Coming Technical Meetings.

Engineers' Club, Philadelphia, Pa.—Regular meeting, Feb. 16. Secy. Howard Murphy, 1122 Girard St.

Engineers' Club of Kansas City, Mo.—Regular meeting, Feb. 18 Secy., Kenneth Allen, 310 Baird Building.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, Feb. 19. "Thomson Electric Welding Process," H. D. Hibbard Secy., S. M. Wickersham, Penn Bldg.

American Institute of Mining Engineers. — The 53d meeting will be held at New York, on Feb. 19. Secy., R. W. Raymond, 13 Burling Slip, New York.

American Society of Civil Engineers, New York.—Regular meeting, Feb. 20. Secy., John Bogart, 127 E. 23d St.

Engineers' Club of St. Louis, Mo.—Regular meeting, Feb. 20. "Elevated Railways," Geo. H. Pegram; "Tests of, and Specifications for, Cast-Iron," Prof. J. B. Johnson. Secy., Wm. H. Bryan, 709 Market St.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, Feb. 20. Secy., S. E. Tinkham, City Hall.

New York Railway Club.—Next meeting Feb. 21. Rooms, 113 Liberty St., New York City.

Western Society of Engineers, Chicago, Ill.—Regular meeting, Mar. 6. Secy., John W. Weston, Gaff Building.

Civil Engineers' Club of Cleveland, O.—Regular meeting March 12. Report on Applied Science. Secy., James Ritchie, Case Library Rooms.

New England Railway Club, Boston, Mass. — Regular meeting, March 13. Boston & Albany passenger station.

IT will be well perhaps that we should call the special attention of readers interested in railway field-work to the slope-board illustrated in our issue of Feb. 2, in connection with a communication by Mr. W. R. HILL. The peculiarity of the board was in marking the arc, not with the angle in degrees, but with the horizontal distance for a rise of 10 ft. or other vertical distances between, contours. Thus the reading "5.5" means that the ground rises 10 ft. in 55 ft. or (since cot 10° 18′ = 5.5) is a 10° 18′ slope. In this way the same scale is used for spacing off the contour as the other work of mapping, whereas otherwise we must use two scales in succession. Again, the mind readily estimates the slope in this way on the ground, especially after some practice, whereas an angular reading conveys little idea to the mind without a great deal of practice. Thus considerable errors are less likely to creep into the notes, which are more easily extended by estimation, as should always be done for a short distance at least. It is one of those little points which often aid a good deal in advancing work smoothly.

IN a late paper on "The Channel Tunnel" read before the London Society of Arts, its author, Col. HOZIER, made a telling point against the class of Englishmen who fear invasion from the existence of such a tunnel, by showing that the Alps were also as formidable a strategical barrier between France and Italy as is the Channel between England and France; yet neither of the Continental nations hesitated to pierce this barrier, at Mt. Cenis and St. Gothard, when it became a question of easier commercial intercourse between the two countries. The stand taken by the anti-tunnel element in England is not complimentary to their fellow-countrymen, and shows less confidence in the national means of defence than was evident in Italy, for example. If one tunnel under the Channel is dangerous, two or three tunnels through the Alps should certainly make it more dangerous for the weaker nation. As it is by encouraging commerce that a nation becomes rich, and accumulates the means for carrying on effective warfare, when war is necessary, it seems that the Continental plan is by far the wiser course of the two. In fact, the invasion scare is too absurd to be entertained by any other than a very conservative Englishman who wants his country to remain an island simply because "it always was an island," forgetting the fact that in this century commerce will take the easiest path regardless of national prejudices, and traffic across the Channel under existing conditions will be avoided when possible.

A VERY few years ago a bridge across the lower Mississippi was deemed an engineering impossibility owing to the deep alluvial bottom and the requirements of river navigation that called for spans of dimensions then unheard of, if spans of any kind were to be permitted. But the advance in the art of founding bridge piers has been so rapid, and spans have been stretched to such a length, that old-time objections have been met, and engineers stand ready to bridge almost any space for which capital will provide the means. As to the Mississippi river at the present date—another bridge is under contract at St. Louis, one is started at Memphis, another is chartered at Natchez, and now a company is organized for the construction of a bridge at New Orleans with every indication of being pushed to completion. For many years the broad Mississippi made a gap in all east and west railway communication, for a thousand miles and more of its course; but that day has passed, and in the next decade we may look for bridges wherever the traffic needs or the public may demand them. The bridge across the Atchafalaya river in Louisiana, opened to travel in December, 1883, may be claimed as one of the chief and first object-lessons in economically crossing rivers with deep alluvial bottoms The grand work of Captain EADS at St. Louis preceded it; but the expense was enormous, and the employment of compressed air had there reached its practicable limit at about 110 ft. The bridges required lower down the valley could not hope for rock foundations, and the danger of scour and the requirements of the case called for foundations deeper than those at St. Louis. The Atchafalaya cylinder foundations were sunk to depths exceeding 120 ft., and in some cases 115 ft. below the soil level. The success of this work was due to improved dredging appliances, and a somewhat similar outfit put down the deep cribs of the Poughkeepsie bridge. The later success at the Hawkesbury bridge of the same dredging firm that sunk the Atchafalaya foundations has robbed the problem of deep foundation in alluvial soil of much of its former terrors; and as spans of over 500 ft. are now becoming common, the bridging of the Mississippi river is to-day practically resolved into a question of capital-raising.

LI HUNG CHANG, the Viceroy of China, is reported as having lately made the assertion that within the next half-century China would be covered with a network of railways; that it would have rolling-mills and furnaces, with immense mineral resources and unlimited cheap labor to back them, and that "China *may* do the manufacturing for the world." While China is proverbially slow in adopting the methods of the "outside barbarians," a striking change has been taking place there lately; and to-day China has an excellent fleet of iron-clads of the most modern type, is arming and disciplining its soldiers after European models, has telegraph lines and at least one railway in successful operation, and is pushing forward in a phenomenally rapid way, for conservative China, towards the acquisition of the majority of the arts and manufactures that but lately marked the difference between it and other more civilized nations. The industrial momentum of a nation of 400,000,000 inhabitants, covering one-tenth of the inhabitable globe, if once fairly started, is well worthy of consideration.

Baron RICHTHOFEN, in describing the North-west of China, says that the Shansi district is one of the most remarkable coal and iron regions in the world; and he estimates that at the present rate of consumption the coal of this district would supply the world for thousands of years to come. It is claimed by some writers that Shansi, when more thoroughly explored, will bear away the palm from Pennsylvania, whose 20,000 sq. miles of coal-land have been heretofore considered as the greatest single deposit in the world. RICHTHOFEN says further that this coal can be very easily and cheaply extracted on a large scale, and that iron-ore of excellent quality is found in quantities in the immediate vicinity of the coal-fields. Be this as it may, mineral wealth is abundant; and when it comes to a question of labor, the Chinese can furnish this to an almost limitless degree, and recruit it from a class that is naturally patient, skillful, and content with small gains. We do not agree with the Viceroy in his prophecy that all he hopes for may be accomplished in 50 years—China is too deeply settled in its rut for that, and other nations, with the many advantages they already possess, will be moving too at an always accelerating rate; but the Chinese may some time be very active competitors in the manufacturing world, and it may become necessary for other nations than our own to protect themselves with "a Chinese wall" against Chinese industries.

THE creation of the new Department of Agriculture, while the Public Works department of governmental work is in its present disjointed and inchoate condition, is another proof of how mysterious are the impulses which inspire the average Congressman. We are not saying that it is not a good thing to have a Department of Agriculture. Possibly it might be a good thing to have a dozen or twenty "ministers" for all sorts of purposes, like most of the British colonies, in some of which, like British Columbia, almost every man who wears good clothes has to take his turn at being a Minister of something, at some time during his life, in order to find enough men to fill the "Cabinet." There are several departments besides a Department of Public Works which might be usefully created, perhaps, as for instance, a Department of Internal Commerce, or Manufactures, or Education, with all of which the Government has much more to do directly

than it has with Agriculture. But there is probably no new Department which could have been created which would be looked on by so many voters as a kind of indirect tribute to themselves, and effort to promote their interest, as a Department of Agriculture; and in this, no doubt, we have the true explanation of the ease with which the bill creating it has been put through. The only visible duties for it, of much importance, are the distribution of seeds, the collection of statistics, and the conduct of a few usually profitless agricultural experiments — all of them duties which may reasonably be supervised by a Bureau officer. It is possible that the effect of the creation of the Department will be good, for this country is becoming so vast, and the work of the Government with it, that it is highly desirable that its management should be so subdivided as to be under the control of more than seven men. The principle once established that new departments may be created for sufficient reasons and that there is no law of nature requiring that there should be seven only, one or two other departments are likely to follow in time, and among them a Department of Public Works.

BUT when one contrasts the reasons for the creation of a Department of Public Works and a Department of Agriculture he cannot but feel amazed that the latter should be the one first created. The Government spends tens of millions annually in public works, through officers scattered about in a lawless way—often a very absurd way—in each of the several departments. Much of this work is done at cross-purposes and duplicated, and all of it at great disadvantage from being a side issue of the several departments to which it is attached. Some grave injustices, like the relative status of army and civil engineers on the public works, which are admitted by every one, but cannot be corrected as things now are, require correction. In every way it is plainly most desirable to consolidate these great technical sub-departments under a single harmonious management with more or less of a common staff ;yet all efforts have failed so far to induce Congress even to take interest enough to seriously consider the matter. There are not many voters whose votes hang on their action as to such a department, while it might seriously interfere with their log-rolling abuses of the public funds for the benefit of their "deestrict."

The new Department of Agriculture will be a god-send to the comic papers, which will doubtless picture the bucolic Secretary in many amusing guises; but what department of legitimate government business he will properly represent it is difficult to see, while anyone can see what a power for good a well-organized Department of Public Works would be and what very great governmental interests it would have in charge.

Flat-Topped Rails.

The interesting paper by Mr. DON J. WHITTEMORE, which we are now publishing, on the proper relation to each other of the forms of rails and wheels, propounds a somewhat novel theory which is quite certain to command attention, and certainly ought to, since, as Mr. WHITTEMORE remarks, it bears on one of the most important and fundamental questions of railway practice now unsettled.

Mr. WHITTEMORE'S theory, in brief, is that rails and wheels are being destroyed by the fact that the rails crown on top, so that the tread bearing is only on a point or narrow strip, with the result that the load is so concentrated as to crush the metal of the rail and wear away the wheel-tread in a groove. He proposes as a remedy that about 2 ins. of the tread of wheels shall be made truly cylindrical, and about 2 ins. of the top of rails dead flat, and thus obtain for both 2 ins. of horizontal bearing surface instead of at most 0.2 in. as is now most common.

On the question which has heretofore attracted more attention, and on which a committee of the American Society of Civil Engineers has recently reported, the proper corner radius of rails and interior fillet radius of wheels, Mr. WHITTEMORE expresses substantial accordance with the preliminary conclusions of that Committee, viz., that the corner radius of wheels should be as sharp as is practically convenient, and conversely, the fillet radius of wheels as large as is convenient, to the end that the rail and flange may be prevented from coming into contact as long and as completely as possible, rather than to make the two radii identical so as to promote and insure such bearing and rubbing contact. To this conclusion all engineers and practical railroad men seem to be coming, and it is in any case apart from our present subject to discuss it. It requires a change in the Master Car Builders' present standard wheel-tread to conform to it, however, since the M. C. B. standard was adopted with the express view of "conforming" to the corner radius of rails. Mr. WHITTEMORE'S theory, if accepted, will require a further change in that standard. Moreover, there are still many men whose opinion is entitled to great respect and consideration who are either not satisfied in mind as to the proper relation of rail and wheel sections, or hold affirmatively that the two should correspond in corner radii, so that even the latter question cannot be accepted as settled; but as it is entirely different one from that of the form of the top of rails, we for the present assume the corner radii to be dissimilar, as required both by Mr. WHITTEMORE'S paper and the committee report referred to.

In that committee report, the precise form which should be given to the top of the rail was considered only incidentally, and, as we happen to know, was not given any special consideration by any of the members of that committee, prior to the appearance of their report, since they felt that they had enough to do in considering the much more debated question of the form of the corner. Such reference as there was to it was to this effect, and almost in these words: that as it was not clear that additional bearing surface was an advantage, even for the tread, where there was no question of rubbing friction from a longer contact line, it was still more doubtful whether gain could arise from longer bearing contact down the side of the rail, which necessarily carried with it a good deal of rubbing friction.

Mr. WHITTEMORE controverts this position by asserting that additional bearing contact on top *is* an advantage, while admitting the objections to the other form of contact, and supports his position by a weighty array of facts, some of them quite new, which it has seemed to us proper to reproduce almost in full, and which we will now briefly summarize.

The most interesting fact brought out is positive evidence from comparative wheel wear that the locomotive drivers cause vastly more wear than the more lightly loaded car wheels, thus confirming exactly the conclusions to which all engineers have come from a study of rail wear. The almost universal conclusion of those who have so studied the question has been that, although the locomotive driving wheel base constitutes only from 5 to 20 per cent. of the weight of average trains, yet at least 50 per cent. and probably 65 to 75 per cent. of the rail we is caused by that wheel base, and only the mainder by the much larger weight of the cars. It is in the nature of things impossible to determine directly from rail observations how much of the wear is caused by locomotives and how much by the cars, since the two kinds of wear go on simultaneously; but by comparison of the wear of rails on grades, where the proportion of locomotive weight is great, with the wear on level divisions, where the proportion of locomotive weight is small, and by other indirect methods of that nature, the fact is so well established as to be now generally admitted.

There have been a number of German records of the comparative wear of locomotive tires and car-wheel tires which have helped to establish this theory, but the German conditions as respects loads and running gear are so different from our own, as to make such records of little value to us, except comparatively. The general fact that there is a material contrast in the durability of locomotive and car-wheel treads has been known for a long time to many practical railroad men and engineers, and is one of the facts which have helped to establish the law of rail wear above alluded to. But it has been left to Mr. WHITTEMORE to be the first to make these important records available in contrasted form, as he did in the part of his paper published last week, with the following highly significant contrast:

Relative Durability, Locomotive and Car Tires.

Railway.	Class of engine or car.	Drivers. Diam. ins.	Drivers. Load per wheel, tons.	Tons duty per ½-in. wear.
London, Brighton & South Coast	Passenger engine	76	8.4	60,800,000
Chicago, Milwaukee & St. Paul	Freight and passenger engine	62	7.0 to 10.0	41,000,000
Chicago, Burlington & Quincy	Switch and freight "	44 to 57	11.0 to 14.8	31,380,000* 20,674,000*
Chicago, Milwaukee & St. Paul	Coach tires	33	2.75	164,757,428
" " "	" paper wheels	33	"	149,130,000
" " "	" " "	42	"	177,544,398

* 4-in. tires. † 3-in. tires.

For formula for computing tons duty, see middle of last column of page 117 of our last issue.

In other words, the car tire requires something like 4 to 6 times as many revolutions to produce ½-in. tread wear as a locomotive tire. The precise figures of the contrast might readily prove to be quite different if a greater body of facts were collected, but there is quite enough collected to fully establish the general fact.

But the fact being established, what does it mean? Mr. WHITTEMORE claims that "the facts presented indicate pretty clearly that failure does not result so much from abrasion as from some other cause," the "other cause" in his mind being plainly crushing or deformation of section, especially at the joints. If the claim means that the vast majority of modern rails fail by such deformation, and not by wear, we are assuredly not disposed to

dispute it; but if it means that the facts show that the *form* of the rail has been the aggravating cause of the tendency to deform, or that anything else but abrasion proper is necessary to explain all the wear which actually occurs, we fail to see where the indications to that effect come in. Not, we repeat, that we are opposing the theory or practical conclusion in favor of a flat-topped rail; on the contrary, we are disposed to favor it, as a change which at the worst should prove harmless and might do much good. But before beginning a radical change of that kind, it is well to be sure that there are grounds for believing that it will be effective, in part at least, lest it finally prove that we have been "barking up the wrong tree" and that things go on with the flat-top rails much as before, while time and money are lost by the diversion of our attention to the wrong issue. This would be the result, we fear, of a sudden adoption of flat-top rails—not that it will do harm; not that it may not do good; but that it may not do enough good to be noticeable, because the flat top is not the primary cause of rail failure.

In the first place, the great increase of rail and wheel wear from increase of load, which Mr. WHITTEMORE so conclusively proves, does not in the least imply that such wear proper (as distinguished from deformation) as occurs is due to anything else but abrasion, because the rate of abrasion itself increases very rapidly with pressure. One reason why it does so is evident from the fact that the coefficient of adhesion between rail and wheel increases so rapidly with pressure. The coefficient is the measure of the extent of interlocking of the fibres from which abrasion results; and, while we do not recall any experiments showing directly the difference in rate of abrasion from differing loads, yet the general fact that two rubbing pieces of metal if loaded with twice the load, will abrade much more than twice as fast is well established. It does not, therefore, in the least follow that such wear as occurs comes from direct crushing of the fibres, which would be aggravated by concentration of load, instead of from abrasion proper, which would be, in a measure, independent of the area of the surfaces in contact, since it would be increased by a greater number of fibres in contact as well as diminished by a smaller unit load. It is a fact beyond dispute that brake-shoe wear and friction is much greater after the worn or bearing surfaces have become large than when they are small. It is not apparent why the opposite should hold with wheel treads in any marked degree.

Now, the negative evidence that crushing wear proper, as distinct from deformation, does not occur is pretty strong. In the first place, a wheel bears but for an instant of time in the same spot, affording much less chance of crushing the material (except for impact effects) than when a heavily loaded wheel stands in the same spot for a long time. Under the latter conditions the most delicate tests will fail to show the slightest distortion of surface, as we know from individual tests on new rails with heavy locomotives. After a locomotive has stood still for several days on the same spot of new rails, the surface ought to have taken enough permanent set to have a ray of light reveal it by a difference in the glistening of the surface if the mere weight were destructive; but such is not the case. In rapid motion there is undoubtedly an increase in dead weight from oscillation and a decided impact effect due to imperfections of surface; but if this were the provoking cause of wear (*i. e.*, loss of weight) is it not reasonable to suppose that wear would be much more spotty than it is, great for a few feet, little a few feet beyond, and greatly different on good and bad track? Yet such is not the case. Such differences occur, but not to a marked degree. On the other hand, we know that sliding of rail on wheel is always going on everywhere because of difference in diameter of wheels, non-parallelism of axles, lurching from side to side, etc.; and since an even smaller amount of such sliding than we have reason to believe exists suffices to explain the observed wear, by contrast with the excess of wear on curves which is all due to sliding friction; and since such sliding occurs in a manner consistent with the approximately uniform rate of rail-wear per rail, half-rail, and quarter-rail, why is it rational to assume that direct crushing effects cause the wear in default of any experimental evidence of that fact?

There remains, therefore, the question of how far deformation by crushing may be supposed to be aggravated by a curved rail-top with diminished tread bearing contact. Mr. WHITTEMORE gives an interesting table, published in this issue, showing the comparative safe loads on flat-top and curved-top rails with various radii of rail and wheel, stating that it is "not given as a play upon figures, but as an educator of the judgment"; but is it really a safe educator? We cannot see that it is. It is founded confessedly upon a formula of Prof. FREDERICK GRASHOF devised for use in proportioning bridge rollers. An extension of it to the far different radii and conditions of rail on wheel is plainly a dangerous experiment and not necessarily conclusive. Mr. WHITTEMORE himself objects to a similar extension of an analogous formula, made by the committee above mentioned in their report, where it is stated that "in good practice it is considered entirely safe to load steel rollers rolling on steel up to an equivalent of 10,000 lbs. per lin. in. for 33-in. wheels," implying that this is not true; yet, as it happens, this was computed directly from Mr. WHITTEMORE'S own formula at the foot of the table of "Average Crushing Load for Metals," on page 438 of Trautwine's Pocket Book.

Now, does not the table of "Allowable Pressures," which appears elsewhere, prove too much? According to it the allowable pressures are, for an elastic limit of 40,000 lbs.:

	60-in. wheel.	33-in. wheel.
Flat top rail	21,519	15,959
12-in. rad. top	6,480	4,812
18 " " "	7,947	5,894

In other words, the flat top will carry about 3¼ times as much load safely as the curved top with a 12-in. radius. If we interpret this as meaning that the flat top is 3¼ times as safe as the curved top against crushing under a given load, this may not strike us as unreasonable, but rather as highly probable; but supposing we put it the other way, and say: "If this is so, we can load our flat-top rail with 3¼ times the present load without any worse results than now occur with the round-top rails," and, after reinforcing our rail and tie support, as we undoubtedly could (by the admirable tie-plates and otherwise) so as to give equal resistance in that respect, and, after flattening off our objectionable top, we should proceed to load our rails, which now carry 8 tons per wheel, or say 4 or 5 tons without injury, with 13 to 17 tons per wheel! Our fibre strains, if Prof. GRASHOF is to be believed, would be no more intense than before, when no harm was resulting; but does any one believe that harm would not very quickly result under these new conditions? We are satisfied that no one will claim it, and why this comparison is not a perfectly fair one we fail to perceive.

Assuming, however, that it is not, let us see what the real difference is between a flat-top and curved-top rail. Assuming a 2½ in. rail head and 12-in. radius, the difference is a film of metal about 0.035156-in. high in the center, and of as nearly as may be 0.079101 sq. in. area. Now it is perfectly true that large aches from little toe-corns grow, and it is certainly *possible* that the addition or subtraction of this little mass of metal has an immense effect on the life of the rail. We apprehend that the addition or subtraction of a not much larger amount of metal from the rail corner does have such injurious effect; but that is because the rail tends constantly to the form which we do *not* want at the corner, and the addition of this metal delays the process. In the case of the top crown, whether we use it or not, the rail tends constantly to wear flat, because the highest point of the rails takes the most wear, and in process of time they do in fact wear nearly flat. Is it then likely that all our manifold woes with rails, or any large part of them, are in fact flowing from the slight delay to this process from the little crowning now used in rail sections? We find we must pause for a reply, at least for a week, since not only is our space exceeded, but we are running ahead of the so far published part of Mr. WHITTEMORE'S paper, which we will complete next week.

The Pacific Railway in 1849.

The Pacific railway problem, as given in Mr. WHITNEY'S pamphlet of 1849, and elsewhere presented at greater length, shows in some of its features a boldness of conception and a foretelling of what are now facts that is remarkable. His proposed method of building the road might be open to objection now; but at that date the capital required was too great to be raised from private sources on the mere issue of stock and bonds; and his fear that Government control would result in sectional jealousy and conflict was well founded, as proven by subsequent events. His proposition to make it a National road, merely self-supporting and no more, belonged to the day when the idea was seriously entertained of giving each farmer along the line of the State railway of Pennsylvania the right to haul his own cars, by his own horses, on the common State railway. His plan was really in advance of his day, and was probably the best that could then be formulated with any prospect of immediate success. His rail section of 64 lbs. to the yard was also far ahead of the practice of 1849, and in fact that of nearly 20 years later.

His proposed trunk lines, intended to connect the principal centers of commerce as they existed in 1849, may be compared with the systems of 1889, about as follows: The north and south line, connecting Mobile with his point of crossing of the Mississippi river at Prairie-du-Chien, is to-day represented by the Mobile & Ohio, as far as Cairo, and above that by the Illinois Central, though the Chicago that was unknown as a railway center in 1849, has since become the point of attraction for this and many other systems. The Vicksburg, Montgomery, Macon line is built upon; and, in fact, nearly every line shown on this map is to-day occupied by a main railway route. In the north, our map lays down the main system of the New York Central, Pennsylvania Central, Baltimore & Ohio, etc.; omitting the line down the Hudson river in the first, because it was a bold man who would at that date suggest railway competition with river navigation. The older systems of the Eastern and Middle States were, of course, planned on paper in 1849, and the appearance here is not remarkable.

It is across the great plains of the West that

our pioneer promoter had the greatest latitude of location; and it speaks well for his close study of the meagre data then accessible to notice how closely he has fallen upon the routes of later careful surveys. As elsewhere remarked, his line from the South Pass to San Francisco only differs from the present route of travel in passing to the south of the Great Salt Lake, instead of to the north of it; and it is even now a question whether his was not the best natural route. From the Pass east, he follows the present route a certain distance down the Platte river, but leaves it to reach Leavenworth and the route to St. Louis, instead of going on down the river to the Omaha of a later day. The direct line from Prairie-du-Chien to the South Pass is as yet only built in part; though about half of it is laid down from the east. From the Pass to Puget's Sound the actual Union Pacific follows closer to the Columbia river than Mr. WHITNEY projected it; but it is there. The air-line road from Prairie-du-Chien towards Vancouver may be taken as the Northern Pacific; but it is actually located about as much above the 45th parallel as it is here shown below it. The Southern Pacific road follows the lines of our map very nearly from the coast to El Paso, and from that point to Las Vegas, the Atchison, Topeka & Santa Fé follows one of the map routes pointing towards Independence, and the Atlantic & Pacific, as surveyed, covers practically the other to Memphis.

It is very true that it may be said that Mr. WHITNEY had only to take such points of commercial importance as then were in existence and connect them on paper by guessing at a line. But that his guess should have been generally so close to the routes of travel as now operated is none the less interesting.

Additions to the Vanderbilt System.

Although the most famous financiers of the VANDERBILT family have passed away, the influence of the name VANDERBILT in railway and financial circles is greater now than ever before. The VANDERBILTS are no more engaged, it is true, in brilliant speculations or audacious deals, and they are a distinctly conservative force in financial circles; but the power of their enormous wealth is such that they have no need whatever to scheme with any great adroitness to accomplish their ends, and they can practically have their own way in any deal which they choose to undertake.

We chronicled last week the achievement of the VANDERBILTS in obtaining control of the South Pennsylvania Railroad enterprise, thus removing an ever present danger to the peace of the trunk-line association, while at the same time they gain new power over their chief competitor, the Pennsylvania, to induce it to keep the peace. It is this week announced that VANDERBILT brokers have quietly secured a large part of the stock of the Cincinnati, Indianapolis, St. Louis & Chicago Railroad, commonly known as the "Big Four."

The nature of this deal may be most clearly understood by reference to our map and editorial on "The Railway Systems East of Chicago," in ENGINEERING NEWS of Nov. 10, 1888. As stated there, the "Big Four" road has recently acquired new importance through a traffic-contract made with the Chesapeake & Ohio. Through this, and the completion of the Maysville & Big Sandy Railroad and a new bridge across the Ohio river at Cincinnati, the "Big Four" becomes a link in a new trunk line between Chicago and the sea-board, only 943 miles in length. The capital stock of the Cincinnati, Indianapolis, St. Louis & Chicago Co. is but $10,000,000, and as the stock has been quoted at about 80 for some time, it has been no very difficult matter for the VANDERBILTS to secure a good share of the stock at no great outlay. Whether they have as yet secured a controlling interest is not positively known, but it is practically certain that in future the road will be operated in close harmony with other roads of the VANDERBILT system, and especially with the Cleveland, Columbus, Cincinnati & Indianapolis, or "Bee Line" system, which meets the "Big Four" at Cincinnati and at Indianapolis.

The general effect of the deal will certainly be to ensure still more the maintenance of harmony among the trunk lines. It is true, indeed, that the new Chesapeake & Ohio trunk line was to be controlled by conservative men, who were hardly likely to commit the folly of starting a serious war of rates to signalize the opening of their new road; and the location of the line is such that, as a competitor to the established lines, it could not in any event do very great damage. Still, its influence to stir up strife among the members of the Trunk Line Association might possibly have been considerable. With the VANDERBILTS in control of the link from Cincinnati to Chicago, however, the new trunk line is no more likely to cut rates between Chicago and the sea-board than is the New York Central, although it will be quite likely to secure its share of the traffic which naturally seeks the southern routes—a traffic, by the way, which is likely to have a rapid and considerable increase.

From all appearances, too, the holders of large interests in the Chesapeake & Ohio and the "Big Four," who have not disposed of their interests to the VANDERBILTS, are not displeased at the new alliance, and it is quite probable that the whole Chesapeake & Ohio system, from Chicago to Newport News, may yet be as closely connected with the VANDERBILT system as is the Michigan Central or the Lake Shore.

The benefits which lines of the VANDERBILT system will gain by the new deal are quite obvious. The Cleveland, Columbus, Cincinnati & Indianapolis will secure a direct outlet from the Ohio river to Chicago; and what is much more important, will receive traffic from the "Big Four" lines, for carriage east and west, which until now it has had to share with the lines of the Pennsylvania system. On the strength of this benefit, "C. C. C. & I" stock has had quite a boom.

There are rumors afloat that this new addition to the VANDERBILT system is soon to be followed by another one not less important. The Central Missouri Railroad Co. was chartered in 1885, and for many months its projectors endeavored to secure capital for their enterprise. Ten miles of the road were completed in 1887, but up to a recent date there has always been an evident lack of the funds necessary to push the enterprise to completion. The proposed road is to extend from Alton, Ill., and St. Louis, Mo., to Kansas City, with bridges across the Mississippi at Alton and across the Missouri at St. Charles. Last year the name of the road was changed to the Cleveland, St. Louis & Kansas City. Mr. THOS. C. CLARKE of this city was elected president of the company toward the close of the year; and of late, work has been pushed on the grading and on the preparations for the construction of the great bridges in a way which seems to indicate that ample capital is now backing the enterprise.

The Indianapolis & St. Louis division of the Vanderbilt system runs within a few miles of Alton, and could make connection with the new bridge very readily. The proposed route of the road may be seen by reference to our map of the Southwestern States, published March 3, 1888.

It seems unlikely that an enterprise of this magnitude, which is certain to encounter the powerful opposition of the GOULD system at every stage, would be undertaken by capitalists if it were without the backing of existing roads; and certainly if it is to be built to extend any system, no one seems so likely to be at its back as the VANDERBILTS. On the other hand must be set the fact that none of the trunk lines have shown a disposition to extend west of the Mississippi, that to do so just now would be apt to break the harmony among the trunk lines and among the Western systems as well, and that the VANDERBILTS have every reason to avoid this result.

Such are the facts and such the rumors in regard to this enterprise. We give our readers both, that they may judge for themselves as to the actual truth.

It is altogether likely, in any event, that the real backers of the Cleveland, St. Louis & Kansas City may not be known until the road is completed and in operation; and that if the VANDERBILTS are interested in it, they may keep their interest so subordinate as not to arouse the jealousy of the Pennsylvania managers, and induce an extension of that system to Kansas City.

A NEW ELECTRIC-SWITCH DEVICE.—A new switching device was tested lately in Chicago, according to a Western exchange. It is an electrical appliance operated from an ordinary switching tower. The switches are all moved by one lever, which has an interlocking attachment adjusted by a dial movement operated by electricity. The interlocking attachment of the lever catches a corresponding attachment on a wire which moves the signals. The machinery is simple, and the only obstacle to its easy operation is the rusting of the connecting wire. In the shed where the interlocking machinery is placed is an annunciator, also worked by electricity. There is an adjustable rail connecting with a broken electric circuit about 100 yds. from the outer signal at the crossing. When the engine comes on this rail the circuit is closed, the bell rings, and a card announcing the train, road, and direction of the train is turned on the annunciator. The operator at the lever then moves his machine to give the requisite signals. If no movement is made, the danger signal stands. If a false move is made at the outer signal, there is a chance to correct it at the home signal. The operation of the lever is so simple that the movement is easily made. In making the change, the lever has first to be moved to the danger signal, which is a further precaution. In connection with the home danger signal it is proposed to operate a derailing switch, worked by the same machinery as the signal. This is a wedge-shaped switch rail with heavy flange and about 3 ft. in length. No train could possibly pass over it. It would lead to certain ditching when ditching is necessary. The device is the property of the La Grand Switch & Signal Company, HORACE SCOTT, President. Col. LE GRAND is the inventor.

PERSONAL.

Mr. JOHN A. COLEMAN has been appointed Commissioner of Public Works, Providence, R. I.

Mr. C. M. DAVIS of Poughkeepsie, N. Y., has been appointed Superintendent of the Yonkers Street Ry. Co.

Mr. THOS. DEWITT CUYLER has been appointed Vice-President of the Cleveland & Marietta Ry. Co.

Mr. L. A. MACKEY, President of the Bald Eagle Valley Ry. Co., died at Lock Haven, Pa., Feb. 8.

Mr. CHAS. H. JONES, Jr., has been appointed General Manager of the Suffolk & Carolina Ry. Co., with headquarters at Suffolk, Va.

Mr. GEO. H. BOUGHMAN has been appointed City Engineer of Wilmington, Del., succeeding Mr. F. H. ROBINSON.

Mr. I. C. DOWNES has been appointed Superintendent of Water-Works at Lewiston, Me., for the unexpired portion of the term of the late Capt. L. C. PECK.

Mr. GEORGE S. HUBBELL, C. E., has been appointed Sanitary Engineer to the Board of Health, Buffalo, N. Y., vice Mr. WM. B. GESTER resigned.

Mr. A. EVANS of Cincinnati, O., has been appointed engineer of the Dayton and Michigan Division of the Cincinnati, Hamilton & Dayton, vice DAVID E. HARLIN resigned.

Mr. G. B. VAN VORST, inspector of locomotives on the New York Central, died at Schenectady, N. Y., on February 5. He had been connected with the motive power department of the road for several years.

As we go to press, news reaches us of the sudden death of MR. E. S. PHILBRICK, of Brookline, Mass., while on the train between Boston and Brookline. We reserve more extended notice of Mr. PHILBRICK'S life and work to a later issue.

Mr. CORNELIUS H. DELAMATER, the head of the Delamater Iron Works, in New York, died in this city February 7, at the age of 68. The works were founded in 1845 and during the war he did a great deal of work for the Government, especially on Capt. JOHN ERICSSON'S celebrated monitors. Mr. DELAMATER had always been a most intimate associate of ERICSSON, whose inventions, in nearly every instance, were put into his hands for construction. After the war he retired from active management, leaving the affairs of his iron works in the charge of two assistants. A life of quiet did not suit him, however, and in a year he again took the management into his own hands.

Mr. D. H. NEALE, late Mechanical Editor of the *Railroad Gazette*, met with some opposition in his late appointment, as one of the two traveling railway inspectors of New South Wales. The opposing element contended that these positions should have been filled by promotion within the service. But Sir HENRY PARKES logically argued that as the new order of things was instituted, more than anything else with the purpose of infusing new blood in the railway department, this end would not have been secured by promotion. The appointment consequently holds good.

CORRESPONDENCE.

Law for Country Roads.

ALBANY, N. Y., Feb. 12, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

In recent numbers of your journal you refer to improvements in roads in the country. This State certainly needs improved roads and engineering skill and supervision in their construction. There is now a bill pending in the Legislature modifying to some very slight extent the present law, but it does not appear to be radically changed from the old law. If a proper bill was presented, it may be passed and the roads, as well as the engineering profession benefited thereby. If you can suggest a proper bill or refer to the status of other States that appear to be satisfactory, I think something may be done to help the roads of this State.

Very truly yours, H. A.

[We are not just now in a position to furnish our correspondent with the desired information in the short time on hand. But in the interest of our roads generally, we would be pleased to hear from any of our readers who have suggestions to make tending to improve existing conditions.—ED. ENG. NEWS.]

A Syphon Problem.

SAYRE, Pa., Jan. 30, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

An attempt is now being made to drain a swamp near here by a syphon; but the results are not very satisfactory as a continuous flow cannot be obtained. The conditions are as follows: The area is 100 acres, with deepest water in the center; the summit to be crossed is 16½ ft. above the surface of water and 444 ft. from a well sunk in the margin of the swamp, and to this well a system of converging ditches is led.

The plan tried is as follows: A 4-in. cast-iron pipe leads from the well with at least 1 ft. of water above the mouth of the pipe. The pipe is laid carefully with hemp and lead joints. The gradients, beginning at the well, are—a rise of 2 ins. per ft. for 94 ft.; a rise of .005 for 350 ft. to the summit; then the pipe descends with the latter gradient for 1,500 ft.; then falls .004 for 700 ft.; from thence to the outlet, 200 ft., the fall by various gradients is 6.4 ft.

It will be seen that the total fall in the 2,400 ft. from the summit is 25 ft., making the outlet about 9 ft. below the inlet to the syphon. The pipe discharges into the air, but there is a trap a few feet from the outlet which prevents the air from passing up the pipe. There are two 90° bends in the main, which is otherwise straight.

At present the pipe has to be primed twice a day, from a hydrant at the summit, with a pressure of about 65 lbs. During the priming, air rushes out at the relief pipe with considerable force. After being primed, the pipe runs a full stream for a time; but this gradually weakens until in about 12 hours the flow ceases. An air chamber has been lately placed at the summit, connected at top and bottom with the syphon pipe. This chamber was connected with the town supply, and sufficient water allowed to flow into the chamber to cause a slight but continued overflow from an opening in the top of the chamber. But this and other expedients have failed, though recommended by well-known hydraulic engineers.

The question is whether there is not sufficient fall in the line to make this method a success; or whether there is some fault in the method of operating which may be corrected. W. A. S.

[While this problem is submitted to the hydraulic engineers among our readers, we should say that the fall is too small for that length of main and that the entrance to the syphon is too near the water surface. When the syphon starts with a full head, a considerable quantity of air is drawn in with it, a fact which is practically utilized on a more perfect plan by Mr. HYATT in his water aerating device. This air, by gradually accumulating at the summit, checks the flow until sufficient air has gathered to stop it altogether. Not being acquainted with the local conditions, we cannot suggest amendment in these two features. Perhaps some of our readers can find a better solution to the problem.—ED. ENG. NEWS].

Safe Stresses in Bridges.

ROCHESTER, N. Y., Jan. 27, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

Referring to page 34, in your issue of the 12th inst., I may say that it was as much a surprise to me as it was to MR. PEARL to find "a mathematical dodge" in my deduction of the formula for unit stresses on page 330 of your Vol. 17. Experience, however, has given me such faith in the formula that I look with suspicion upon any formula differing very much from the straight line. The equilateral hyperbola used by many of our best engineers, and given by Mr. PEARL, is based upon the assumption that the allowable unit stress for live or variable load is constant for all values of $\frac{m}{M}$. Now my experience leads me to believe that this unit stress is a variable, that it is less in a counter than in a chord, is less in a chord of a short span than in a chord of a long one. In other words, instead of the equation:

$$\frac{M}{a} = \frac{m}{t} + \frac{M-m}{u}$$

we should have

$$\frac{M}{a} = \frac{m}{t} + \frac{M-m}{u\left(1+v\frac{m}{M}\right)} \qquad (1)$$

By solving this equation and assuming that

$$t = n\,u \qquad (2)$$

and $$v = \frac{2n}{3} - 1 \qquad (3)$$

we derive the equation

$$a = \frac{t\left\{1+\left(\frac{2n}{3}-1\right)\frac{m}{M}\right\}}{n-\left(n-1\right)\frac{m}{M}+\left(\frac{2n}{3}-1\right)\left(\frac{m}{M}\right)^2} \qquad (4)$$

The dotted lines in the diagram illustrate this curve for the two cases: $u = 7{,}500$, $t = 15{,}000$, $u = 5{,}000$, $t = 15{,}000$. The straight lines with which these curves so nearly coincide are the well-known straight line,

$$a = u\left(1+\frac{min.\ B}{max.\ B}\right) \qquad (5)$$

and the straight line I proposed two years ago,

$$a = u\left(1+2\,\frac{min.\ B}{max.\ B}\right) \qquad (6)$$

respectively, and it goes without saying that no practical engineer would hesitate to use these instead of the curves.

The full curved lines are the equilateral hyperbola forms for the same limiting values.

I regret that I have not the leisure to state as fully as I could wish the reasons upon which equation 4 is based. The chief assumption, viz., that the allowable unit stress for live or variable load varies for different values of $\frac{m}{M}$ is, I believe, consistent with the experience of all engineers, so that it is not necessary to state my own reasons.

A. D. OTTEWELL.

The Oregon Pacific Cattle-Guard.

CORVALLIS, Ore., Jan. 26, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

In your issue of Jan. 19, 1889, you spoke of the Oregon Pacific cattle-guard as merely a grill resting on stringers. The plan shows ties used under the slats, preserving the regular road-bed system. The triangular slats are so lightly spiked upon the ties as to be no detriment in case of derailment. The aim in all the standard plans has been to carry the tie system unbroken across all cattle-guards, open culverts, and other structures, rather than to cross such structures with the rail laid on stringers only as is the custom on so many roads both East and West. The pit is also nearly 3¼ ft. deep below top of rail, and is a more prominent feature in actual construction than appears in plan.

In your issue of Jan. 19 you speak of the guard-rails as not being far enough apart on open culverts. The standard, common ties of the road are 8 ft. in length. A derailed wheel that could not pass between the guard rails as shown, would be off the end of the ordinary tie, and it was believed, would be sunk too low in the fill and too badly demoralized to be benefited by bridge ties, even of indefinite length. Possibly we are in error on this point, and present it, as we have the drawings, in order to benefit by criticism. Yours truly,

ARCH. A. SCHENCK.
Div. and Office Eng.

[Experience seems to show that wheels stick to the road-bed a long time, even when off the ties, especially in winter, when the ground is frozen. In any case, it is obviously preferable that the wreck, if it comes, should be on the solid road-bed and not at a small open culvert. The Chatsworth, Ill., disaster, last year, showed what such small openings can do, and the extra expense of giving derailed wheels as much leeway on them as they have on the road-bed, is very trifling.—ED. ENG. NEWS.]

Sewer Formulæ.

MEMPHIS, Tenn., Feb. 5, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

It gives me pleasure to note, in your issue of the 26 ult. how freely Mr. HERING admits the anticipation of his sewer formula; and were he not inclined to class mine as the last of the list, I would say no more. But in the article to which I referred in my former communication, I say that the formula "has been used by myself and friends for several years." In order to be more definite, I will now say, since 1873.

Very early in my practice I learned how unreliable was the CHEZY formula

$$v = c\sqrt{R\,S}$$

with c as a constant. I believe that in 1871 there was no formula for velocity in use in this country in which c was a variable; though WEISBACH'S appeared to be such. In this year the admirable report of Messrs. DARCY and BAZIN ("Recherches Hydrauliques") came into my hands. It was then five or six years old. This gave me

$$c = \sqrt{\frac{2g}{A+\frac{B}{R}}}$$

By a very simple reduction this becomes

$$c = \frac{m\,R}{\sqrt{\quad}}$$

For a year or two I used this form of a coefficient. I cannot tell just when I first used the later form, but in an old note book (1872-3) I find that I used for cast-iron pipes under pressure, the following:

$$v = \frac{71\,D}{\sqrt{D}+0.0624}\sqrt{\frac{H}{L}}$$

This is certainly the form under discussion, and is such a one as might suggest itself to any one who was using the modified form of DARCY and BAZIN. In fact, it can hardly be considered more than another modification of their formula.

Recognizing fully, what I believe was first shown by these eminent engineers, that the nature of the channel affected the flow, I had already formed a goodly group of constants from recorded experiments; and for the form

$$v = \frac{m\,R}{\sqrt{R}+n}$$

It might be well to add here that the above formula for cast-iron pipe was given to E. VAN LIEN, C. E., and (I believe) to E. L. DUNBAR, C. E., of Bay City, Mich., as early as 1875.

Unless Mr. HERING can show something prior to 1873, I can justly claim the form under discussion as mine; though it was hardly of the "new formulæ" considered in my article of 1885.

My formula is intended for grades *greater* than 1 in 2,000, not *less*. The misprint or writing is too evident to have been commented on.

In conclusion, I will say that I am confident that the constants 176 and 0.65 will fit best the average condition of brick sewers. R. F. HARTFORD.

Graphic Traverse Tables.

BALTIMORE, Md., Feb. 4, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

In your issue of Dec. 15, 1888, page 461, you describe a graphic traverse table prepared by M. LORINI of the engineer office of the Department of Public Works of

Yonkers, N. Y. I beg to state that the above is nothing new: I have one that I made during the year 1879, and I had used one prior to that date.

I first discovered and used it whilst engaged on the geographical surveys west of the 100th meridian, in charge of Capt. GEO M. WHEELER, U. S. Engineer.

Mine is a quadrant of a circle 20 ins. in diameter; this quadrant is, therefore, 10 ins. radius, this 10-ins. is divided into 200 parts. You can read off the sines, co-sines, versed sines, co-versed sines, and to a certain limit the tangents, co-tangents, secants, and co-secants to any degree or fraction of a degree.

From your description a person would almost suppose that some parts of it had been taken from mine. I can give all necessary proofs of the above facts.

Very respectfully,

CHARLES P. KAHLER, C. E.
Asst. City Commissioner.

[A person who should suppose so would be making a quite unnecessary, not to say unfair, supposition, for the idea of a graphic traverse table is probably as old as graphics itself. We have ourselves known of the use of the idea in substance for many years. The novelty of Mr. LORINI's device lies simply in its convenient form, and in saving the great trouble of construction.—ED. ENG. NEWS.]

Light and Heavy Rail Sections.

Chicago, Milw. & St. P. Ry.; General Roadmaster's Office,
MILWAUKEE, Feb. 2, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

A year and a half or two years ago, there was published in ENGINEERING NEWS a letter by me upon the merits of light and heavy rails, in which I made some criticisms upon the latter, and to which you took exception in some arguments which at the time seemed good and reasonable.

From careful and studious observations upon rail-wear since that time, however, I have seen no reason to withdraw from the main grounds which I then took, but many reasons to confirm me in them; and as the subject of rail-wear is now being quite extensively discussed, I will take the opportunity to add to my previously expressed views, and to give what, from my experience and study of the subject, leads me to think may be in the direction of a remedy for the existing defects of our lately designed rails.

The subject of rail-wear has been brought into prominence lately by what seems now to have just come to light, but which has been well known to be a fact by practical track-men for four or five years past; and that is, that the heavy rail sections which have recently been adopted on many roads have been *failures*, so far as wear is concerned.

As to this fact the scientific press and the proceedings of engineers' and roadmasters' conventions have been unaccountably silent. Again and again we have seen it heralded that this and that railroad, in a laudable and progressive spirit, were relaying their lightrails with those of heavier section, and thus providing a more perfect track. We never saw anything published of the situation on those roads, six months or a year afterwards—how the trackmen discovered the ends of the big rails to be battering; how they tamped them the harder in a vain endeavor to stop the trouble; how the roadmasters complained to the superintendents that they wished they had back their old rails again; and how the superintendents hauled the roadmasters "over the coals" for not keeping up the track, and "tore their hair" with disappointment when they could not locate the blame.

At the time I wrote the article previously referred to, the C. M. & St. P. Ry., to provide better track for its new service of limited trains, was relaying one of its divisions of 140 miles with 67-lb. rail, and taking up 58-lb. rail which was still in good condition after 7 or 8 years service. This new rail was made by an Eastern company which stands as high as any in the country, and which claims to have taken special care in the manufacture of it; its joints were fastened by angle-bars weighing 60 lbs. per pair, three times as heavy as those of the old rail, and it was laid by the best trackmen on the road; yet after the first winter there were 50 rails in condition to be removed from the track, and many more damaged.

Now why was this? That is what is puzzling the railroad managers, engineers, and roadmasters, and the rolling mill men. All have their theories, and I have had several; but one after another I have been forced to drop them under the pressure of contradictory facts, until I have been entirely at a loss for an explanation.

I am convinced that this rail trouble is not caused by poor road-bed, for that has been yearly improving; it is not from the use of weak joint fastenings, for these are far stronger than those in use ten years ago, and no form or strength of joint fastening will prevent a poor rail from battering; it is not from the use of poor ores, if we are to believe the assertions of the manufacturers, who claim that they now use ores equal, if not superior, to those used formerly. Chemical analysis fails to afford a satisfactory explanation, and the excessive weight now brought on car wheels, although partly accountable, does not cover the whole ground.

How about the form of rail section? There, I think, is the seat of the trouble.

The present generally adopted section of heavy rail has a very large head and a light and delicate web and flange. Most of the weight of the heavy sections over that of the light ones is made up by adding metal to the top of the head, under the erroneous impression of the designers that thereby so much more metal would be available for wear, while the web and flange are kept at the same weight as those of the light sections. Now there is no fault in this section so far as it may have a properly shaped head and a sufficiently strong web and flange; but the root of the evil lies in the fact that, having a thin web and flange in the rolling of these rails, *the blooms must be brought to a very high heat* in order that these parts may not cool off too much before the finishing pass; and thus the head receives its compression while still at a high heat, which its mass retains, and loses that refining which rolling at a lower heat produces. This is a point brought out in a recent paper by Mr. ROBT. HUNT, giving a short history of steel-rail manufacture in this country, and I believe it is the correct explanation which we are looking for, as the history of the steel rail sections used on this railroad points unmistakably in that direction.

The first steel rails laid by the C. M. & St. P. Ry. were laid in 1868. They were of Cammell Sheffield steel and of 56 lbs. per yd. weight. The head of the rail is 2⅝ ins. wide and 1-in. thick, the web ⅝-in. thick and the flange proportionally thick. In 1872 and 1873 the section, in both foreign and American steel, was nearly the same as above, the web being reduced to 9-16-in. and the flange slightly thickened. From 1874 to 1879 the head was narrowed and thickened, but the web and flange remained the same as before. All of these sections are 4 ins. in height, and of clumsy appearance compared with those designed afterward, but they are all, unexceptionally, excellent wearing rails.

In 1880 our present standard 60 lbs. 4¼-in. section, and later our 67 lbs. 4½-in. section, were adopted. The head was increased in size and the web and flange lengthened and reduced in thickness. Immediately our trouble with the rails wearing and crushing at the ends began.

I have heretofore looked upon the dissimilarity in form of sections as merely an attending circumstance of, and not a reason for this trouble, which I attributed to the new processes of manufacture which were introduced about that time, and to various other causes, but I now think we have the true cause right at hand, instead of in the remote places where we were searching for it.

What, then, is the remedy? I say, go back to the examples of the sections which we used prior to 1880, and adopt a section of whatever weight, with more equality of mass in the head, web, and flange, so that the whole section of rail may be finished at about the same heat, and that heat a low one. If the head of the rail be made as thin as is consistent with required strength, it will radiate its heat more rapidly and conduce to the above result. Such a rail will warp less on cooling and will require fewer blows under the straightening press, which injures so many rails, and the heavier the rail the greater the injury.

There is no question that, if heavy rails can be made to equal the wear of the old-time light ones, sections up to 100 lbs. weight would soon be adopted; but with such discouraging failures staring them in the face, railroad managers are wisely disposed to move cautiously in the matter.

Yours truly,

GEO. B. WOODWORTH,
Supr. of Steel Rails.

[We are disposed to attach very great weight to the view herein expressed. The evidence tending in that direction has been accumulating and is very strong. The metal itself, for the most part, is proven; but no metal, however good, makes a good rail if rolled too hot on its last passage through the rolls, and how can that be avoided when the shank and base are much thinner and cool so much more quickly? That this view is spreading among rail men will appear from a collection of sections which we have now on hand and shall shortly publish, pending which we forbear further discussion.—ED. ENG. NEWS.]

Notes, Queries and Answers.

L. S. LEVERSEDGE of Dallas, Texas, asks us for the address of parties manufacturing a good machine for making 3 by 2 ft. ditches in surface prairie land. We can only refer our correspondent to the Bucyrus and Marion Co's., the Vulcan Iron Works, and a number of other firms whose addresses will be found in our advertising pages.

G. E. C., Tarrytown, N. Y. As the system of keeping level notes given is one not generally approved by engineers, and in our judgment not one to be commended or taught, we cannot publish the communication. See Henck's Fieldbook for the better and more generally used system.

C. C. of Newburg, N. Y., asks for best published data on systems of emptying cesspools at small cost, that would answer the needs of a suburb awaiting the building of a trunk-sewer. We would be indebted to any of our readers referring to latest practice in this direction.

BOOK REVIEWS.

Report of the Commissioner of Education for the year 1886-87. Washington, D.C., Pub. Doc. pp. 1170.

This magnificent publication is calculated to give every intelligent man a keen sense of the great amount of valuable work which is done in our governmental offices. It has certain obvious and irritating defects common to Public Documents and due to careless editing and utter indifference to the value of space, but it is a treasury of information on the subject of education in the United States and abroad, which every one interested in it must receive with great satisfaction as an emphatic evidence that our much-abused governmental offices do much good work.

A brief statement of the contents of the volume by chapters shows how broad is its scope. They are in succession: Work of the office; State common school systems; Digest of State school reports; Discussions of Educational questions by State superintendents, etc.; City; School systems; Training of teachers; Kindergartens; Secondary instruction; Superior instruction (for women; universities; scientific schools); Professional instruction; Manual and industrial training; Education of special classes (blind, deaf, etc.); Gifts and bequests to Education; List of notable benefactors; Educational associations and conventions; Libraries in the United States; Educational periodicals; Education in foreign countries; Papers on Educational subjects.

All these subjects are very fully treated, not always exhaustively, and we may be sure not always wisely, but with an immense agglomeration of *facts* on almost every head which admits of statistical analysis. Thus, in the chapter on noteworthy gifts and bequests, which includes only gifts of $500 or more, during the single year 1886-7 there is record of 209 gifts, 25 being of $50,000 or over, 72 between $5,000 and $49,000, and 112 less than $5,000. The highest gifts were: $800,000 by JOHN BREWSTER to Brewster Free Academy, of Wolfborough, N. H.; $630,000 by E. PRICE GREENLIEF to Harvard library; and $500,000 by JACOB P. JONES to Haverford College, Pa. Ten gifts were of $100,000 or over. The aggregate is not given (one of the frequent omissions from such publications), but from a hasty summary it amounts to over $5,000,000, which has been already largely exceeded this year, and which may be stated with confidence to be far below the present average yearly aggregate of such contributions. As the principal of these sums is usually made a permanent investment, and largely invested in real property, whose value increases rapidly, the rate at which such educational funds are increasing is something quite without precedent in the history of the world, and it is well that the facts should be thus annually collected; albeit the list is probably far from exhaustive, and moreover includes nothing but gifts to institutions of learning. It is not generally known how much more is given by individuals to such purposes in this country than anywhere else in the world.

There were in the United States 11,818 regular and 508 honorary degrees conferred in the year 1886-7. Of these there were 4,241 in letters; 1,616 in science; 405 in philosophy; 11 in art; 657 in theology; 3,957 in medicine; and 931 in law. Nearly half the honorary degrees were in theology, only 16 in science, 32 in philosophy, and none in medicine.

The total number of and attendance at colleges and scientific schools has changed in ten years as follows:

	1875-6	1885-6
No. of colleges only	309	300
" " students attending	26,243	34,315
" " colleges and scientific schools	370	371
" " students	32,211	41,161
Population per college student	1,713	1,690
" " college and sci. sch. student	1,395	1,398

The decrease in number of colleges is only apparent and due to a larger number not reporting; but the general fact that our growth is chiefly in the strength of colleges, and very little in number of them, is encouraging.

The population per student in both colleges and scientific schools in the different sections was remarkably uniform, standing as follows:

Population per student	*Colleges only*		*Col. and Sci. sch.*	
	1885-6	1885-6	1875-6	1885-6
North Atlantic	1,309	1,281	1,076	945
South Atlantic	2,080	2,338	1,691	1,786
South Central	2,475	2,585	2,077	2,322
North Central	1,701	1,615	1,499	1,421
Western	1,280	1,726	1,043	1,403
Total U. S.	1,713	1,690	1,395	1,398

Considering how many students from other sections attend the North Atlantic schools, this indicates a nearly equal proportion of students receiving the higher education in all sections, at least among the white populations. The existence of a large colored population in the Southern States is to be remembered.

The statistics of scientific schools are as follows, omitting all preparatory departments:

U. S. Scientific Schools	Endowed with Gov. land grants	Not so endowed
No. of schools	33	32
" " instructors	589	382
" " students	4,314	8,062
" " graduates	456	322
" " volumes in library	213,449	173,817
Value of buildings, etc.	$6,707,799	$2,630,605
" " productive funds	10,169,308	6,501,325
" " income from do.	563,204	153,041
" " " " State	397,838	244,429
" " " tuition fees	200,138	134,894
Total income	1,207,516	631,279
Benefactions in year	302,800	31,950

In contrast with this, the "colleges of the Liberal Arts"—whatever that antiquated phrase may really mean—have an endowment in buildings and productive funds of over $90,000,000 for 43,474 students; the theological schools have nearly $18,000,000 for 6,306 students; the law schools less than $1,000,000 (of separate buildings and funds) for 3,185 students; and the medical schools about $5,000,000 for 16,366 students. Science is visibly coming to the front.

Of colleges and seminaries for the higher education of women, there are 159 with 20,772 students.

The statistics of libraries are very full, covering in all 1,779 libraries with 14,012,370 volumes, against 3,647 libraries with 12,276,964 volumes in 1875-6, a very small apparent increase concealing a very large real one. The difference is due to the fact that all college and school libraries and all libraries of less than 1,000 volumes are now omitted. The Commissioner contents himself with remarking: "It is obvious, therefore, that the lists presented in this chapter cannot be compared with those heretofore published by this Bureau," with that frequent obliviousness of public officials to the fact that even a few hours' faithful work by a single man would make such superficially discordant record readily comparable. It is irritating to see such valuable records thus carelessly treated; but after all, the facts are there for those who choose to dig them out. We cannot attempt it, but we infer that the real growth of libraries in this period has been about 100 per cent.

An unusually full and complete index to previous publications of the Bureau covering 78 pages, and an index to the volume covering 62 pages, closes the volume, which is so good as to make one wish it were a little better, but to make him very thankful for what it is.

PUBLICATIONS RECEIVED.

—*Proceedings of the 22d Annual Convention of the Master Car-Builders' Association*, held at Alexandria Bay, N. Y., June 12, 13, 14, 1888. Printed for M. C. B. Association. Pamphlet, pp. 222, 5 folding plates. $1.00.

The proceedings at the convention of this most useful association, we have previously summarized. The report is in the usual form, and full of information. No one interested in its subject matter should be without it.

—*The Comparative Danger to Life of the Alternating and Continuous Electrical Currents.* By HAROLD P. BROWN, Elec. Engr. 201 West 54th St., New York. pp. 61.

The nature and conclusions of this pamphlet are fairly expressed by the following type-written challenge which appears on the back cover:

"I therefore challenge Mr. WESTINGHOUSE to meet me in the presence of competent electrical experts and take through his body the alternating current, while I take through mine a continuous current. The alternating current must have not less than 300 alternations per second (as recommended by the Medico-Legal Society). We will begin with 100 volts, and will gradually increase the pressure 50 volts at a time, I leading with each increase, each contact to be made for five seconds, until either one or the other has cried enough, and publicly admits his error. I will warn Mr. Westinghouse, however, that 160 volts alternating current for five seconds has proved fatal in my experiments, and that several men have been killed by the *low tension* Jablochkoff alternating current."

We cannot attempt to summarize the pamphlet, but Mr. BROWN seems to us to make out a pretty strong *prima facie* case. The keenest impression of the disinterested reader is likely to be that it is not altogether healthy to monkey with either buzz-saw, and that there is a very unnecessary and improper amount of high-tension current wires strung through our streets.

—*Combustion in Locomotive Fire Boxes.* By ANGUS SINCLAIR. New York; National Car & Locomotive Builder. Small pamphlet. pp, 21. 25 cts.

A meritorious little pamphlet addressed primarily to locomotive firemen, and explaining in simple terms the whole theory of combustion. It is well calculated to do good among the class to which it is especially addressed, and may be read with profit by any one.

—*The Stevens Indicator*: January, 1889.—Published at the Stevens Institute of Technology, Hoboken, N. J.

This number contains the following papers: "Hydraulic Forging Machines," Prof. COLEMAN SELLERS: "Railways and Locomotives in England," ROBT. G SMITH; "Corrugated Boiler Furnaces," A. P. TRAUTWEIN; "Water Consumption of Engines," Prof. J. E DENTON; "Amateur Photography," F. N. CONNETT; "Steam Consumption of Non-Condensing Engines." "Water Gas as a Steam Boiler Fuel," Prof. D. S. JACOBUS; "The Geyer-Bristol Electric Meter," Prof. WM. E. GEYER; "The Future Water Supply of Northern New Jersey," WM. KENT.

—*Tables of Moments of Inertia and Squares of Radii of Gyration*; supplemented by others on the Ultimate and Safe Strength of Wrought-Iron Columns. By FRANK C. OSBORNE, C. E., M. Am. Soc. C. E., Member of the firm of G. W. G. FERRIS & Co., etc. Second Edition, 1889. Engineering News Pub. Co., Publishers. *Price*, $2.00.

In previously noticing this book, we have already pointed out its many features of usefulness to engineers and draughtsmen engaged in designing structural works in iron or steel. In this edition 12 new tables of moments of inertia and squares of radii of gyration have been added, and other tables have been extended until the total number of sections has been increased from about 300 to 1,900. Other matter has been added of value to the user, and the work now stands as a most valuable adjunct to every draughtsman's table and engineer's library. No other work contains anything like the same collection of built sections of forms in present general use. All of these are "open sections," as now required in the majority of specifications.

—*Journal of the Franklin Institute.* February, 1889.—Published by the Franklin Institute, Philadelphia, Pa.

This number contains the following papers: "The Nicaragua Canal," by Commander A. C. TAYLOR, U.S.N.; "Spirally Welded Steel Tubes," by J. C. BAYLES; "Some American Contributions to Meteorology," by Prof. WM. M. DAVIS.

—*The Growth of Industrial Art.*—Arranged and compiled under the supervision of the Hon. BENJ. BUTTERWORTH, Commissioner of Patents, etc. Washington, Government Printing Office, 1888.

This publication in 200 large folio pages records pictorially the advance made in many of the mechanical arts. Each page is devoted to a single subject; and commencing with the earliest attainable type follows the subject, chiefly by patented devices at decade intervals, to its latest development. What text there is, is in the form of historical and statistical notes at the foot of each page on the subject there treated. The compilation of the material has involved an immense amount of labor, and the result will doubtless be interesting to many. The objection we would make, however, is to the poverty of text and the failure to give sources of information for the earlier forms and methods here shown. A line or two under each cut would have added but a trifle to the expense, and would have very greatly increased the usefulness of the work.

SOCIETY PROCEEDINGS.

Engineers' Club of St. Louis.—At the meeting on Feb. 6, President MEIER in the chair, Mr. SEDDON, chairman of the special committee on legislation on bridge reform, reported progress.

Prof. J. B. JOHNSON read a paper on "Cable Conduit Yokes—Their Strength and Design." The paper gave the results of a number of tests made on different shapes of yoke at the Washington University testing laboratory. Sketches of the different forms were made, showing where each had failed. The author submitted a design for a new form of yoke composed of cast-iron, strengthened by a steel or wrought-iron tension member. The cost need not exceed that of ordinary yokes, and seemed to offer a remedy for many of the existing difficulties. In the discussion Mr. HOLMAN spoke of the width of slots in use in St. Louis, that of the Citizens' road being ⅝-in. and of the Olive street line ¾-in. He thought the proposed design of yoke would prove a success, unless unforeseen complications, due to extreme changes of temperature, were introduced by the use of two separate members. He described the Lane yoke used in Cincinnati, which was very strong; also the Chicago yoke, made of wrought-iron tee irons. He stated that the most important question now affecting cable lines was the amount of contraction of the yokes. It was not known whether this would continue indefinitely, or whether a permanent shape would be reached, or whether repeated contractions and expansions might be expected. Should the contraction continue, most of the yokes would break, which, with the difficulty of keeping the slot open, would necessitate enormous outlays of capital.

Mr. BRUNER gave some data on the effect of ground freezing, and stated also that very little reliable information was to be had on this subject. In his opinion a ¾-in. slot was better than a ½-in. Mr. VAIL gave a description of the yoke adopted by the St. Paul lines, where the frost line was about 6 ft. below the surface. Mr. RUSSELL showed that the stiffness of the yoke seemed to have no effect on the amount of slot closure. Mr. SEDDON spoke of the stresses which come upon the yoke, due to freezing of the ground, and suggested that it would be impossible to design a yoke to withstand the strain; but as the yokes do stand the service, it showed the need of further investigation.

WM. H. BRYAN, *Secretary.*

Montana Society of Civil Engineers.—This Society held its second annual meeting at the office of Chief Engineer BECKLER, of the Montana Central R. R. at Helena, Mont., on Saturday, January 19, 12 members being present.

The Society was organized in June, 1887, and has at present 51 members; 3 applications for membership were received, and 2 new members declared elected:

The Committee on Memorial to the Legislature, praying for the establishment of proper remuneration for expert testimony, reported progress.

The following officers for 1889 were elected.

President, B. H. GREENE; *Vice President*, E. H. BECKLER; 2d *Vice President*, H. B. DAVIS; *Secretary*, J. S. KEERL; *Treasurer*, C. W. HELMICK; *Trustee*, THOS. T. BAKER.

After some further business the Society adjourned to meet Monday morning, at the Montana Central depot, where a special car was to be provided for the trip to Butte City.

A very enjoyable three hours' ride brought the members to the Silver City, where they were enabled to realize more fully than ever before the wonderful mineral resources of the Territory. Mines in the very heart of the city are a sight not to be witnessed elsewhere, and smelters that keep a gray pall of sulphur smoke constantly overhead had a tendency to make the Knights of the transit feel that sheol was not far distant. The party was met by the local members, and immediately proceeded to the Montana Union depot, where a train was waiting to take them to Anaconda, some 30 miles.

At Anaconda they were met by Superintendent STALLMAN, and assistants RAUP, DUNSTAN and WEBB of the Anaconda Smelting Co., who escorted them to the Company's boarding house, where they discussed lunch.

The Company's plant consists of the "upper" and "lower" works, the former being about 8 years old, and the latter about 2.

The lower works were first visited, and, viewed as a whole, gave the engineers an excellent idea of the vast magnitude of the enterprise. The works are situated on a series of magnificent terraces, extending 200 to 300 ft. up the side of the mountains. The masonry of the retaining walls of these terraces is of almost cyclopean construction, the stones being of unusual size, carefully bedded and jointed, and laid in cement. Looking at them, one is carried back to the Aztec ruins and the descriptions of Assyrian architecture, and the wonder is, not that the plant cost $13,000,000, but that so much could be built for the sum. Each terrace was devoted to a separate operation, one to the BRUCKNER furnaces, another to the reverberatory melting furnaces, etc.

Among the labor-saving appliances noticed was the method of distributing the coal, which was dumped from the cars upon an endless belt. At each furnace boards are so arranged that by dropping them on the belt, the coal is shoved off from it. Another peculiar arrangement is the method of disposing of the slag by allowing it to flow from the tap-hole into a stream of running water which granulates it and carries it off.

The smoke from all of the furnaces is carried by a tunnel which unites them all, to the base of a stack about 150 ft. high, the orifice of which is 400 ft. above the floor of the lower furnaces.

Next the concentrating department was visited. This is terraced in the same manner, but, owing to the topography of the mountain, about at right angles to the smelting department. Here the ores are prepared for the smelter by stamping and washing. The stamps were formerly of the usual cam and gravity type, but these have been replaced by a new type consisting of an ordinary steam hammer working in a hopper. The ram has a certain amount of revolving motion, to insure perfect pulverization of the ore, which is then carried by a stream of water to the rockers and settling pans.

During the winter the works are driven by a compound engine of 1,000 I. H. P., supplied by 2 marine boilers of 500 H. P. each, lowered with a non-conductor composed of sawdust and plaster of Paris, which is giving excellent satisfaction. The stack is 200 ft. high.

During the summer the power is derived from turbines placed near and below the engines. Wire rope transmission is a noticeable feature of the machinery. The entire plant is lighted by electricity furnished by 8 United States dynamos.

Between the smelting and concentrating departments is an incline, up which the materials and stores are hauled by cables.

The storehouses contained between $200,000 and $300,000 worth of every imaginable sort of supplies, arranged in the neatest and most perfectly methodical manner. Next the fire-brick works were visited; but nothing striking was seen.

The "upper" or old works were now inspected; but as the processes are the same, we need only mention that their capacity is 1,200 to 1,500 tons daily; and as the capacity of the lower works is about the same, the total amount of ore handled daily averages the enormous aggregate of 2,500 tons! The difficulty of securing the proper handling of the large number of cars required is so great that the company has been obliged to commence building a road of its own to Butte, some 30 miles, where its famous mine is located.

At 6 P. M. the party returned to Butte, where, after a hasty lunch, a meeting was held in the court rooms, at which some interesting papers were read, and at 10 the

meeting adjourned to the Metropolitan, where an excellent banquet of ten courses was served, and at 3 A. M. the members dispersed. The next day the Helena contingent returned home after voting the trip a grand success.

The Northwestern Society of Civil Engineers and Architects has been organized in Portland, Ore., with twenty charter members. President, Capt. CLEVELAND ROCKWELL; Vice President, WM. STROKES; Secretary, R. A. HABERSHAM; Treasurer, J. KRUMBAIN; Librarian, H. G. GRADON.

The Western Railway Club.—At the meeting of the club at Chicago, Feb. 19, the subjects for discussion will be "Standard Axle for 60,000 lb. Cars" and "Tender Trucks." WALTER D. CROSMAN, *Secretary*,
818 Rookery Building, Chicago.

The Pittsburg Meeting of the R. P. I. Alumni was a great success. About 125 members were present, including among these Mr. JAMES HALL, State Geologist of New York, and Mr. W. H. BOYD, of Detroit, graduate of more than half a century ago, or the class of 1832. The excursions were duly made and enjoyed, and the banquet was all that would be expected from a body of engineers out for a holiday.

Association of Dominion Land Surveyors.—The sixth annual meeting will be held at Ottawa, Ont., Feb. 19, 20, and 21. Officers will be elected and reports of committees read. The following papers are to be presented: "An Indian Battle Ground," J. A. KIRK; "A Method of Predicting Lunar Occultations," W. F. KING; "Practical Prospecting for Gold and Silver, and the Preliminary Developments of Metalliferous Veins," JAS. BRADY; "Height of Clouds," OTTO J. KLOTZ; "The Status of our Profession," J. W. HARRIS; "A Standard of Precision," J. A. KIRK; "Gunter's Chain," S. BRAY; "Coal Mining," C. A. MCGRATH; "Measurements," J. BROWNLEE; "A Plea for Pioneers," Dr. ROBT. BELL; "Hon. D. W. Smith, the first Surveyor-General of Upper Canada," JOHN MCAREE; "Photo-Topography in Italy," Capt. E. DEVILLE; "The Other Side of the Question," THOS. FAWCETT; "Distance Measuring Micrometers," W. F. KING; "Suggestions in Forestry," A. L. DRUMMOND; "Settlement and Irrigation of Portions of the N. W. Territories West of the Eastern Limit of the Missouri Coteau, and South of Township 30," WM. PEARCE; "Suggestions regarding Geograpnic Nomenclature," A. T. DRUMMOND; "Government Surveys in Manitoba and the Northwest," J. S. DENNIS; "Surveys of the Province of Quebec," G. E. MCMARTIN.

There will be an exhibition of instruments and a microscopical exhibit of biological and rock specimens, also lectures on "Supposed Fossil Trees discovered at Kingston, Ont.," H. N. TOPLEY; "The Instruments used in the Profession," W. F. KING; "Birds and Mammals of Canada," JOHN MACONN. ARTHUR O. WHEELER, of Ottawa, Ont., is Secretary.

Association of Provincial Land Surveyors of Ontario.—The fourth annual meeting will be held at Toronto, Ont., on February 26, 27, and 28. Reports of officers and committees will be presented and general business transacted. The following papers are on the programme: "Original Landmarks," MAURICE GAVILLER; "Cadastral Surveys in the Province of Quebec," J. P. B. CASGRAIN; "Amateur Photography," "City Surveys," T. B. SPEIGHT; "Descriptions," O. J. KLOTZ; "Timber Exploring," W. R. AYLESWORTH; "Awards and Plans under Ditches and Watercourses Act," LEWIS BOLTON; "Railway Right of Way Surveys," by C. G. HANNING, H. J. BROWN, J. DAVIS, and H. D. ELLIS; "Brantford Water-Works," T. H. JONES; "Wooden and Composite Bridges," H. K. WICKSTEAD; "The Transit," J. MCAREE; "Decimal vs. Duodecimal Measures," V. SANKEY; "Reproduction of Plans," WILLIS CHIPMAN of Brockville, Ont., is the Secretary.

Engineers' Club of Kansas City, Mo.—At the meeting on January 21, the Secretary read a paper by A. N. CONNETT on "Electric Railways." The Observation Hill Railway, Allegheny, Pa., is in successful operation with 60 per cent. curves of from 40 to 200 ft. radius. The maximum grade, 12¼ per cent., is on a reversed curve with radii 100 and 200 ft., and is overcome at a rate of 6 miles per hour. The West End Street Railway Co.'s line, at Boston, was described. Losses in transmission of power by electricity were stated to vary from 25 to 40 per cent. In this, as in wear and tear, cost of construction and operation, electric railways have the advantage of cable railways, but their rolling stock is more costly. Cost of overhead system about $5,000 per mile and of conduit system not over one-quarter that of a cable railway.

The Secretary then read a paper on "Shrinking of Material and Settlement of Embankments." Railroad specifications generally require 10 per cent. added to embankments to allow for settlement. This was considered unjust, especially when required to be removed at contractor's expense. Personal observation corroborated Rankine, Cressy, Trautwine, etc., in that earth takes less room in bank than in cut, and in scraper work it was thought unnecessary to allow shrinkage.

The annual meeting was held Jan. 28. At the regular meeting on Feb. 4, a paper on "The Details of Iron Highway Bridges" was read by E. W. STERN and discussed, bringing out the especial merits of the Schwedler Truss for long spans and describing details of ordinary practice. KENNETH ALLEN, *Secretary*.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Baltimore & Drum Point.—Mr. OLIVER W. BARNES, Consulting Engineer to this Maryland company, favors us with the following information:—About 25 miles of grading are completed in Calvert county and about 13 miles in Anne Arundel county, and contractors Watson, Walsh & Foley and Rogers & Clement are at work on the 44 miles remaining on the main line from Baltimore to Drum Point. A branch is under survey from Conaways, a point on the main line 20 miles south of Baltimore, to Washington, D. C., a distance of 20 miles.

We have also received the prospectus of the company giving a full account of the enterprise and its present status. Six acres of ground have been purchased for terminal facilities in Baltimore, and ample space has also been secured at Drum Point. The harbor at Drum Point was said by the late Prof. BACHE of the U. S. Coast Survey, to be the finest on the Atlantic coast, with the possible exception of that at Portsmouth, N. H. The especially favorable features of the enterprise are described in the prospectus, and with the large amount of public subscriptions already secured, it seems destined to financial success. The offices of the company are at No. 10 South St., Baltimore. AUGUSTUS ALBERT is President and NICHOLAS GOLDSBOROUGH is Chief Engineer.

Lake Erie, Essex & Detroit River.—Chief Engineer JOSEPH DE GURSE of Windsor, Ont., writes us that the tracklaying on this road in 1888 was from Walkerville to Ruthven, 35 miles, and that construction will be resumed on the remaining 3 miles, required to complete the road to the village of Leamington, as soon as the weather will permit.

New York, New Haven & Hartford.—At a meeting of the directors on Feb. 9, President CLARK was authorized to let contracts for a new transfer steamer to take the place of the *Maryland*, which was used to transfer trains from Harlem to the Pennsylvania Railroad tracks at Jersey City, and was burnt some weeks ago. The new boat will be 250 ft. long, and will be built of iron with 15 water-tight compartments, and so far as possible will be fire-proof. She will have better lines and more powerful engines than the old boat, and is expected to make the 12-mile run with 8 loaded passenger cars in 1 hour.

A resolution was passed directing Chief Engineer CURTIS to begin surveys at once for an extension of the Berlin branch from New Britain to Farmington, Conn., about 6 miles, and it is intended to build the line in time for use in next summer's excursion traffic. Plans are also under discussion for extensions from Winsted, Conn. to Lee and Lenox, Mass., and from New Canaan to Danbury, about 12 miles. No definite time for undertaking these extensions has yet been set, however.

Housatonic.—President WM. H. STARBUCK has admitted before a committee of the Connecticut Legislature that the desired increase of capital stock, and the amendment to the company's charter permitting it to build branches 30 miles in length, are for the purpose of constructing a line from New Haven to New York City, to parallel the New York, New Haven & Hartford. It is quite doubtful whether the Legislature will permit stock to be issued for this purpose; but if it should do so, railway construction would probably be quite active in Connecticut during the coming season.

St. Joseph Valley.—This Michigan road, extending from Buchanan to Berrien Springs, 10 miles, is to be sold to the highest bidder at Berrien Springs on February 26 by the Receiver, D. H. PATTERSON. The road has not yet been used for passenger traffic. B. HELMICK of Buchanan was General Manager, and WM. R. ROUGH was President.

Providence & Worcester.—This company is before the Massachusetts Legislature asking permission to lease its road for 99 years to the New York, Providence & Boston Co. (the Stonington line).

Hartford & Connecticut Western.—T. W. BURT of Hartford is in charge of the surveys for the extension from Tariffville, Conn., to Springfield, Mass.——It is expected that the line from the Poughkeepsie bridge to Silvernail's will be open for traffic in about 6 weeks.

New York, Ontario & Western.—The *Financial News* quotes President FOWLER as follows:

The directors have concluded to build an extension from Hancock, on the main line to Scranton, a distance of 51 miles. Work has already begun at various points. I would not undertake to build an independent competing line from tidewater to the coal fields; but our main line already covers a distance of 100 miles from tidewater to Hancock and we have ample terminal facilities at Cornwall and Weehawken for handling a very large tonnage. We have already had several propositions from responsible financial people in New York and London to take the securities of the company and to provide ample funds to build and equip this extension to the coal fields.

It is rumored that the company will begin work soon on an extension from Cornwall, N. Y., to a junction with the Hudson Suspension Bridge & New England road near Fort Montgomery, and thence to a point on the Northern Railroad of New Jersey below Haverstraw. The extension would require a tunnel under Crow's Nest mountain.

An extension is under consideration from Grahamsville to Fallsburg, up the Neversink valley. W. B. ROYCE, of Middletown, N. Y., is interested in the project.

Pennsylvania.—The charter of the Waverly & New York Bay Railroad Co. has just been filed with the New Jersey Secretary of State. The road is to run from Waverly to some point on New York Bay, and J. N. DU BARRY of the Pennsylvania Company holds 1,994 shares of the 2,000 authorized. The proposed road is to be a short cut about 6 miles in length for through trains on the main line and will avoid the disadvantage of running fast trains through Newark. It will necessitate the construction of a long bridge across Newark bay.

At the annual meeting of the Philadelphia & Erie Co. the following report of operations was presented:

Gross earnings—Freight		$3,671,142.11
	Passenger	598,295.32
	Express	41,150.21
	Mail	34,284.24
	Miscellaneous	28,161.42
Total 1888		$4,373,042.30
Total 1887		4,026,931.27
Increase 1888		$346,111.03

The total expense for 1888 showed an increase over 1887 of $276,040.77. The net earnings for 1888 increased $62,570.51 over 1887. The whole number of passengers carried in 1888 was 1,183,761, an increase of 49,115 over the previous year. The freight traffic for 1888 amounted to 8,488,327 tons (2,000 pounds to the ton.) This was an increase of 724,107 tons over the year previous.

The President in his report says:

The policy heretofore pursued in regard to improving the facilities for transportation will have to be continued to meet the increasing growth of trade. Since our last report, extensions of second track and sidings have been made amounting to 8.89 miles in length. The replacing of light rail splices with others of heavier pattern has been continued with satisfactory results. Thirty wooden bridges with an aggregate length of 896 ft., were replaced with iron girders. Eight locomotives were exchanged for others of a heavier class. Ordinary renewals of rails and cross-ties have had a careful attention, and the track, roadbed and other property are in better condition than at any time heretofore.

Philadelphia & Reading.—It is stated that work will begin as soon as spring opens on double tracking the line between Philadelphia & Atlantic City, N. J.—It is rumored that the Reading system is to be extended to Baltimore. The Lancaster & Quarryville branch of the system would be extended from New Providence, Pa., to Conewingo, Md., where it would connect with the new Deer Creek & Susquehanna road, now under construction, and thence with the Maryland Central road to Baltimore. A party of Reading officials visited Conewingo recently, and it is said they secured an option on the bridge which spans the Susquehanna river at that point. The line from New Providence to Conewingo would be about 15 miles in length.

Lehigh Valley.—It is believed that the Jersey City & Western road, which was incorporated 2 weeks ago, is backed by this company, which proposes to secure an entrance to Jersey City independent of the Central Railroad of New Jersey.

Valley (Ohio.)—An ordinance is before the City Council of Cleveland, O., to grant this company permission to consolidate its line by lease or otherwise with any other road not parallel to or competing with the Valley road. At the time of the road's construction, the City of Cleveland gave the company permission to use the old canal-bed on condition that it should never sell or transfer its road to any other company. It is now desired to connect the road with the lines to the south to reach the Ohio river. It seems likely that the desired permission will be granted by the City Council.

Toledo, Columbus & Southern.—The purchasers of this Ohio road announce that work will soon begin on the proposed southern extension. The line will run either to Columbus, or to a point on the Pittsburg, Cincinnati & St. Louis, 20 miles northwest of Columbus.

Northeast & Pennsylvania.—It is proposed to extend this Pennsylvania road from Hartsville to New Hope, Pa.

Evansville & Richmond.—The company has filed a mortgage to the Manhattan Trust Co. of New York, to secure bonds to the amount of $1,000,000, the interest on which is guaranteed by the Evansville & Terre Haute Railroad Co. A large force is at work between Elnora and Freetown, Ind., and the line between Freetown and Columbus is now being located.

Grand Rapids & Indiana.—Surveys are now in progress on the extension of the Big Rapids & Northwestern, a lumber road recently purchased, to Ludington, Mich., about 43 miles. The extension is to be built this season.

Grand Southern of New Brunswick.—This road was purchased last summer by RUSSELL SAGE of New York, and others, and a new company has been formed to be known as the Shore Line Railway Co., which will operate the road.

Canada & St. Louis.—This company has taken the very commendable course of paying the wages of its laborers before all other debts, and it is said that none of its workmen will be allowed to lose by the recent failure

New York, Lake Erie & Western.—The company is to begin surveys next week for an extension of the Honesdale (Pa.) branch northwest across Wayne and Susquehanna counties to Thomson's Station on the Jefferson branch, about 30 miles.

Central Vermont.—The $40,000 in local aid asked by the company for building the 8-mile branch from Waterbury to Stowe, Vt., has been raised, and work will begin as soon as spring opens.

Bell's Gap.—This road, extending from Bellwood to Horatio, Pa., 62.3 miles, will probably be sold to the Pennsylvania. Negotiations are in progress and it is believed that the transfer will take place at an early date.

Baltimore & Ohio.—Work has begun on the trestle approach to the Arthur Kill bridge, across the salt meadows on the New Jersey shore. It will be nearly 3 miles in length.——The new passenger depot at Pittsburg will be opened to the public on March 3.

Dexter & Piscataquis.—Brown Bros. & Co., of St. Stephen, N. B., are letting sub-contracts for this Maine road, but will not begin grading before March 20.

Newburg, Dutchess & Connecticut.—Application has been made by the company for a connection with the new Hudson Suspension Bridge & New England Railroad. A report that the line is to be extended to meet the Central Vermont and Boston & Maine systems has probably little foundation.

Projects and Surveys.

Sanford & Kennebunk.—A bill is before the Maine Legislature, granting E. M. GOODALL, CHARLES H. FROST of Springvale, ROBERT W. LORD of Kennebunk, and GEO. H. NOWELL of Sanford, a charter to build a railway from Springvale, Me., to a connection with the Boston & Maine, at Kennebunk, about 10 miles.

Lockport & New-Fane.—Articles of incorporation have been drawn up granting Hon. WILLIAM SPAULDING, JOHN HODGES, E. L. JAFFERY, and others, the right to construct a line of railway from Lockport, N. Y., to New-Fane Station on the Rome, Watertown & Ogdensburg, a distance of about 10 miles.

West Side Connecting.—FRANK H. EARLE, of Jersey City, Chief Engineer, writes us as follows:

Surveys are in progress for this road, which is to run from Jersey City to Bayonne, a distance of 7 miles. The work is light with easy grades and curves. Considerable progress has been made in securing right of way. GEORGE W. HELME of Jersey City is president. The company was incorporated Jan. 16, 1889.

Lewiston Falls & Livermore.—A bill is before the Maine Legislature chartering the Lewiston Falls & Livermore R. R. Co., to build a line of railway from either Lewiston or Auburn to Bretton's Mills, via East Auburn, Turner, and North Turner.

Beach Creek & Hudson River.—Incorporated in Pennsylvania, with a capital stock of $1,000,000, to build a railway from Newberry, Lycoming county, to Turbotsville, Northumberland county, a distance of 26 miles. Among the incorporators are WHITTON EVANS, EDWARD F. LUKINS, and CHAS. KENNEDY of Philadelphia, and R. C. BELLVILLE of Trenton, N. J.

Evansville, Fort Wayne & Chicago.—It is reported that tracklaying will begin on this road about May 1, on the division between Fort Wayne and Lafayette.

Pittsburg, Cannonsburg & State Line.—A slight correction should be made in the letter published in our issue of Jan. 26, stating that there would be no bridges and few tunnels on the above road. There will be 5 small bridges over the Buffalo creek between Wellsburg and the State line, a distance of about 10 miles, and about 4,000 ft. of tunneling on the whole line between Wheeling and Cannonsburg, 44 miles. The secretary of this company is A. B. COTTON of McConnell's Mills, Pa., instead of Mr. R. A. PAUL, as stated in the issue of Jan. 26. The projectors of the enterprise are having good success in securing the necessary local aid along their proposed line. The total distance from Wheeling to Pittsburg will be 65 miles, and a route has been secured with more favorable grades than those on the Baltimore & Ohio or the Panhandle roads.

Coudersport, Hornellsville & Lackawanna.—The following information has been sent us by the Chief Engineer, C. H. WICKHAM:

The officers of the New York organization of this enterprise are as follows: BENTON MCCONNELL, President; CHARLES ADSIT, Treasurer; J. W. NEAR, Secretary; and C. H. WICKHAM, Chief Engineer. Nothing is being done at present toward construction except procuring right of way.

Owing to a mistake in the report sent us, in our letter published Feb. 2, we gave the name of the Chief Engineer as W. H. WICKHAM instead of C. H. WICKHAM.

Oneonta & Richfield Springs.—A. C. COUCH, of Bridgewater, President, sends us the following:

We have two engineering parties at work relocating this line, surveys for which were made some years ago. The road is to run from Richfield Springs via Hartwick, So. Hartwick and Laurens to Oneonta, a distance of 32 miles, with a branch of 11 miles. We are at present working to obtain right of way; $75,000 in stock is to be taken at par and there will be an issue of $450,000 of first mortgage, 40 year, 5 per cent. bonds. We are open to bids for the construction of the road on or after Feb. 22, 1889. Tracklaying is expected to begin in July and the road will be opened for traffic by December. CHAS. E. NEWHAM is Chief Engineer. The company was incorporated Jan. 31, 1889.

Mendham.—The people along the route of this projected New Jersey road are making great efforts to get the enterprise under way before early spring. The road is a rival enterprise to the proposed Mendham branch of the Morris & Essex R. R., which was started some time ago, but has failed to materialize.

SOUTHERN—Existing Roads.

Anniston & Cincinnati.—It is announced that thi road and the Anniston & Alabama, extending from Atalla via Anniston to Sylacauga, Ala., a distance of about 70 miles, have been purchased by President SCHIFF and General Manager GAULT of the Cincinnati, New Orleans & Texas Pacific road and will hereafter be operated as part of the Queen & Crescent system. If this report is correct, the deal will be an important one to the system, as the purchased road taps a mineral district of great productiveness. Later reports deny the above.

Knoxville Southern.—This road is now under contract from Knoxville, Tenn., to Blue Ridge, Ga., and a large force is at work on the grading. It is expected to have 5 miles of track laid from Blue Ridge north by March 1.

Troy & Tiptonville.—It is stated that the proposed extension of this Tennessee road to Tiptonville will be undertaken this spring. The line now runs from Moffat Jc. to Troy, 4.6 miles. GEO. B. WILSON of Troy is President.

Atlantic & North Carolina.—A bill will be submitted to the North Carolina Legislature authorizing this company to extend its road through Johnson, Harnett, Moore, Montgomery, Stanly and Cabarrus counties, to Charlotte, in Mecklenburg county. To provide funds for this, the company may issue stock to the amount of not more than $600,000, and may issue bonds upon its existing road to the amount of not more than $8,000 per mile.

Cape Fear & Yadkin Valley.—It is rumored that as soon as its extension to Wilmington is completed, the company will establish steamer lines between Wilmington and Norfolk, Baltimore and New York.

Illinois Central.—It is again reported that the company intends to begin construction on its surveyed line from Cairo to Memphis, Tenn., along the Mississippi river as soon as the Cairo bridge is completed. The importance of the extension to the company can best be seen by reference to our map of Southern railway systems in the issue of Feb. 2.

Richmond & Chesapeake.—JAS. B. PACE, T. C. LEAKE, and others have been elected directors of this company, which proposed to build a tunnel under Eighth St. at Richmond, Va., and commenced work some months ago. If the affairs of the company can be satisfactorily settled, it is thought that Messrs. PACE and LEAKE will build the road.

Louisville & Nashville.—The company has offered to extend the Mud River branch of the Owensbo o & Nashville Ry. to Morgantown, Ky., if the people will donate right of way and build a depot at Morgantown.

Georgia Pacific.—A 2-mile extension of the Henry Ellen branch is to be built soon.——It is stated that large contracts are to be placed for additional rolling stock within a short time.

Atlantic Coast Line.—The South Carolina State Railroad Commission have authorized the opening for traffic of the Manchester & Augusta extension from Sumter, S. C., toward Augusta, Ga., a distance of 17 miles.

Projects and Surveys.

Birmingham, Union Springs & Bainbridge.—Chartered in Alabama to build a railway from Birmingham via Columbiana, Shorter's Depot, Union Springs, Clayton, and Abbeville to Bainbridge, Ga., about 230 miles. Among the incorporators are JAS. H. ELY, HERMAN W SMITH, N. H. FRAZER, F. M. MOSELY, G. M. HANSON and C. B. CHAPMAN.

Anniston, Oxford & Choccolocco Valley.—Incorporated in Alabama to build a railway from Anniston to White Plains, Calhoun county. Among the incorporators are S. N. MILLIGAN, O. M. DAVENPORT, A. J. LITTLE, R. J. RIDDLE, and J. F. M. DAVIS, of Calhoun county.

Cleveland, Chattanooga & Augusta.—It is stated that at a recent conference between those interested in several projected lines between Chattanooga, Tenn., and Augusta, Ga., including the Hiwassee, and the Chattanooga, Cleveland & Murphy, it was agreed to unite the enterprises under the above name.

Wythe County.—At a meeting of the citizens of Wythe county, Va., it was resolved to use all possible means to interest capital in this enterprise. The road is projected to run through the counties of Wythe, Carroll, and Bland from northwest to southeast, and will open up a country rich in iron ore, coal, gypsum, marble, building-stone, phosphate rock, and timber. The road will be about 125 miles long, and could be built with grades not exceeding 1 per cent. C. R. BOYD, J. W. ROBINSON, and J. T. HAMLETT, of Wytheville, Wythe county, Va., are interested.

Alabama.—Bills are before the Alabama Legislature incorporating the following companies: The Alabama & Texas Ry. Co., the Florida Belt R. R. & Improvement Co., the Warrior, Atalla & Jasper R. R. Co., the Williamsport & Anniston R. R. Co., the Union Springs & Pensacola and the Union Spring & Chattanooga R. R. Co. The Union Springs & Pensacola is to run from Union Springs, Ala., to Pensacola, Fla. Several prominent citizens of Union Springs are interested, and it is stated that the project will be pushed.

Decatur, Chesapeake & New Orleans.—A. A. MCCORKLE of Decatur, General Manager of this road, is reported as stating that work will be begun at once.

Princeton & Bluefield.—A press report states that a company is being formed to build a line of railway from Princeton, Va., to Bluefield, Va.

Monongahela River.—We have received the following information from J. N. CAMDEN of Parkersburg, W. Va., President:

Surveys are in progress for the Monongahela River R. R., which is to run from Fairmont to Parkersburg, a distance of 35 miles. Good progress has been made in obtaining right of way. The principal sources of traffic will be coal and coke from the coal fields of the Monongahela Coal & Coke Co. It is expected that contracts for construction will be let about April 1; tracklaying will begin about July 1, and the road be opened for traffic in Nov. 1889. I. A. FICKINGER is Chief Engineer.

THE NORTHWEST—Existing Roads.

Chicago & Alton.—The directors have voted the usual quarterly dividend of 2 per cent. on the capital stock. Some of the people who poked fun at the Chicago & Alton managers 2 years ago, because they were so unenterprising and conservative that they would take no part in the boom for new extensions which pervaded the West, are, strangely enough, the very ones who now praise in high terms the Alton's conservative stand and use an unlimited amount of scornful invective toward the managers who took chief part in the extension fever of 1887.

Northern Pacific & Manitoba.—Railway building in Manitoba does not seem to be very expensive. In a discussion in the Provincial Parliament on Feb. 5, Ex-Premier NORQUAY questioned Mr. MARTIN in regard to the construction of the branches of the road. In answer to the question: "What has been expended in the construction of the Morris-Brandon branch?" Mr. MARTIN replied: "I cannot tell exactly. All the work they have done so far is the grading of the 20 miles, and this came to something less than $20,000."

Wisconsin.—Advance sheets of the report of the State Railroad Commission for the year ending June 30, 1888, give the following figures:

Total mileage	5,196.
Total cost	$208,897,606.
Average per mile	40,157.
Total earnings	24,891,619.
Total operating expenses	16,632,135.
Total passengers carried	6,799,951.
Total tons freight carried	11,697,417.

The report of accidents shows that during the year 1888 there were 123 persons killed and 653 injured.

Kaskaskia, St. Elmo & Southern.—B. F. JOHNSTON of St. Elmo, Ill., the President of this company, sends us the following information:

The K. & St. L. R. R. was chartered in 1883, and is to run from Altamont, Ill., via St Elmo, Kinmundy, Salem, Mt. Vernon, Benton, Marion, and Vienna to Metropolis, Ill., opposite Paducah, Ky., a distance of 158 miles. The entire line has been located, with maximum grade of 1 per cent. and curves of 4°, and 35 miles of grading has been completed on the southern end. The line runs through a good farming country, well timbered, and 65 miles of it is underlaid with good coal. The right of way has been secured for 120 miles, and $100,000 in city bonds of Paducah, Ky., has been voted in aid of the enterprise. We are advised that tracklaying will begin within 30 days. JAS. M. BROWN, Room 39, No. 145 Broadway, New York City, is Chief Engineer.

Missouri Pacific.—It is reported that the right of way has been secured for an extension from Crete to Lincoln, Neb., about 18 miles.

Keokuk & Northwestern.—This road, extending from Mt. Pleasant to Keokuk, Ia., will be sold to the highest bidder on March 1 at Keokuk, to satisfy the claims of the bondholders.

Duluth, Red Wing & Southern.—A bill has been introduced in the U. S. Senate, giving this company a charter to construct a bridge across the Mississippi river at Red Wing, Minn.

Projects and Surveys.

Pana & Roodhouse.—The following information has been furnished us by J. C. ESSICK, of Pana, Ill., President:

This road is to run from Pana via Morrisonville, Girard, and Scottville to Roodhouse, a distance of 70 miles. The surveys have all been made, affording a very favorable line through a fine agricultural region containing large beds of lime stone and building stone. We expect to let contracts for construction in the spring, and the road will be open for traffic within 6 months from the beginning of construction. The company was incorporated June 17, 1886. We have no Chief Engineer as yet.

Keokuk & Havana.—A project is on foot in Illinois to build a line of railway from either Keokuk or Quincy to Havana, about 75 miles. This line would bring the cities of Carthage, Havana, Lincoln, Urbana, and Danville into connection with Keokuk and Lewiston, and the Pennsylvania R. R. system. Surveys were made for the road some years ago.

Grand Tower & Cape Girardeau.—Col. VAN FRANK, the Chief Engineer of this road, has just completed the survey of two preliminary lines from East Cape Girardeau to Grand Tower. He reports both lines of the same length, and nearly equal in the amount of work. The

line to be chosen will therefore be the one on which the right of way can be most easily obtained. The locating lines will be run soon, and it is expected that grading will begin about the first of May, and the road completed within a year.

Chicago, St. Louis & Paducah.—Incorporated in Illinois to build a line of railway from a point on the Ohio river at or near the village of Brooklyn, Massac county, northwest through the counties of Pope, Johnson, Williamson and Franklin to Centralia, Ill., together with all necessary branches to iron and coal deposits within a distance of 5 miles from the main line. Among the incorporators are, WM. K. MURPHY, of Pinckneyville; THOS. N. CHASE, of Waterloo; and WILLIAM R. WARD, of Benton. The principal offices will be at Duquoin, Ill.

Cairo & Northwestern.—H. WELLS, of Cairo Ill., Secretary, writes us as follows:

The surveys are all completed for this road, which is to run from Cairo, northwest to East Cape Girardeau, 40 miles. The work is generally light. Fair progress has been made in obtaining right of way. It is expected that tracklaying will begin about Oct. 1, 1889, and the road be opened for traffic in about a year from that date. CHARLES O. PATIEE of Cairo is President, and GEO. W. MORSE of Cairo is Chief Engineer. The company was incorporated in 1887.

Selkirk, Eastern & Western.—A petition has been presented to the provincial parliament by Mr. COLCLEUGH of St. Andrews, Man., requesting a charter to build a line of railway from the southeast corner of the province northwest to Selkirk and along the east shore of Lake Manitoba to Dog Lake, thence south of the Duck Mountains to the boundary of the province at or near Ardpatrick, Russell county. The country through which the road is to run is well adapted to grain growing and stock raising, and in some parts there is abundance of timber, and petroleum, salt and ochre deposits.

Yankton & Norfolk.—A dispatch from Yankton, Dak., states that a party of surveyors began work on this road on Feb. 9. They will locate the line by the same route which was adopted in the preliminary survey made last fall.

Yankton & Missouri Valley.—A bill has passed Congress granting this road right of way through the Yankton Indian reservation. The road is projected to run from Yankton, Dak., to Gettysburg, Dak., about 250 miles. Among the directors are JAMES H. TELLER and J. P. CRENNON of Yankton, and F. F. DAY and EDWARD A. BENSON of Milwaukee, Wis.

THE SOUTHWEST—Existing Roads

Missouri Pacific.—Surveys are reported in progress for a line between Chetopa, Kan., via Baxter Springs and Galena to Joplin, Mo., about 35 miles. The St. Louis Baxter Springs & Oklahoma Co. has just completed surveys over the same route.

Chicago, Burlington & Quincy.—It is stated that engineers in the employ of this company are making surveys for a line from a point near Kansas City to Bogard, Mo., on the Carrollton branch. The new line, if built, would considerably shorten the Burlington route between Kansas City and St. Louis.

St. Louis & St. Francisco.—According to a Kansas City dispatch, this company is making surveys for a line from Ft. Smith, Ark., to Coffeyville, Kan., across the Indian Territory, a distance of about 170 miles. At this point connection would be made with the Kansas City & Pacific, which now runs from Coffeyville to Paola, and this would be extended to give the system an inlet to Kansas City. The story bears all the earmarks of first-class falsehood. When the St. Louis & San Francisco system is to be extended to Kansas City, it is not likely to be built round Robin Hood's barn to get there.

Atchison, Topeka & Santa Fé.—The following is an abstract of a press dispatch from Paris, Tex., which has been "going the rounds" of late:

The disintegration of the Atchison, Topeka & Santa Fé system has begun. Evidently the same policy is to be pursued that was followed in the Wabash wreck—the lopping off of branches. To-day it is announced that the St. Louis & San Francisco has purchased the Gulf, Colorado & Santa Fé branch from this city to Dallas. The line is about 100 miles long. For years the Atchison has struggled for Texas trade, and this surrender is a great surprise.

Even if there had been any truth to the dispatch, the sale of the branch by the Atchison to a company so closely allied to it as is the St. Louis & San Francisco did not call for any such mournful wail as the above. The Paris-Dallas branch might easily be spared by the Atchison without affecting the remainder of its TEXAS system and would be worth much more to the St. L. & S. F. Co. than to its present owners. The reported sale, however, was promptly denied.

Chicago, Kansas City & Texas.—Chief Engineer JAS. R. CHAPMAN will receive proposals till noon of Feb. 20, for grading 9½ miles of this road, requiring the removal of about 19,000 cu. yds. of earth. Profiles and specifications can be seen at 123 West 6th St., Kansas City.

Projects and Surveys.

Nebraska, Kansas & Colorado.—JOHN J. CASS, Treasurer, writes us that the statement published in our issue of Jan. 26, saying that the use of the name of General Manager KIMBALL as one of the directors of this road was unauthorized, is a mistake, as authority was given him to use it by General Manager MELLEN of the Union Pacific last summer. The name of Mr. KIMBALL will, however, be removed from the list of directors for the present.

New Orleans, Natchez & Fort Scott.—A press report states that work on construction will begin at Natchez, Miss., within 2 weeks. Gen. RICE of Fort Scott, Kan., who is still the chief mover in the enterprise, is now at work securing the right of way into Natchez.

Lampasas & Burnet.—A company is being formed at Lampasas, Tex., to build a railway to Burnet, about 20 miles.

Chicago, Kansas City & Omaha.—It is again reported that work on this enterprise is to be pushed during the coming season.

ROCKY MT. AND PAC.—Existing Roads.

San Diego & Cuyamaca.—The desired bonus for this road has been raised at San Diego, and several miles of track have now been laid. Enough rails are on hand to lay 35 miles, and more are on the way around Cape Horn.

Southern Pacific.—The managers of the company state that they have abandoned all idea of building the Pomona & Elsinore railroad. They are of the opinion that Southern California has already more railroads than it can furnish traffic to support.

San Francisco & Northern Pacific.—Surveys are in progress for the extension from Santa Rosa to Sebastopol, Cal.

Union Pacific.—It is reported that a heavy grade near Carbon, Wyo., is to be avoided by building a new line from Sulphur Springs to a point near Dana, a distance of about 25 miles.—— A Helena dispatch repeats the old story that the company intends to build to that point at once.

Northern Pacific.—It is explained that the reason for beginning condemnation proceedings for the lands which they wish to secure at Butte City, was that the title to much of the land was so doubtful that a court decree to settle its ownership would be required in any case. It is stated that a $150,000 station will be erected at Helena this season.

Oregon Ry. & Nav. Co.—It is reported that work will begin in the spring on a line from La Grande to Joseph, in the Wallowa valley.

Projects and Surveys.

Salem, Tillamook & Astoria.—Mr. J. A. MANNING, of Salem, Ore., sends us the following information:

This road is to run from Astoria, Ore., via Tillamook, to Salem, Ore., a distance of 120 miles. Surveys will begin as soon as possible, probably about the first of March. A portion of the route is through a valley affording light work and easy grades, and the remainder through a mountainous region. There will be a large bridge, about ½ mile in length, across the Willamette river at Salem. No right of way has been secured. JNO. G. WRIGHT, of Salem, is interested.

Big Horn Southern.—A bill has passed Congress granting this road right of way across the Fort Custer military reservation, Montana.

Spokane Falls & Northern.—At a recent meeting of the Board of Trade of Spokane Falls, the proposition of D. C. CORBIN to build this road and expend from $2,500,000 to $3,000,000 in construction within the present year, on condition that the city raise a subsidy of $100,000, was accepted. The road is to be completed to Chewelah, about 50 miles, by Oct. 1, 1889.

FOREIGN.

International Company of Mexico.—According to all accounts, the affairs of this company are in a rather demoralized condition. LUIS HULLER, who obtained the concession for the company from the Mexican Government, has been placed under arrest in the City of Mexico, at the instance of English bondholders of the company. According to one report, this is due to the discovery of serious irregularities in Mr. HULLER'S accounts, while it is also stated that the charges against him are based on technical grounds only, and that his arrest is due to jealousies among the members of the company and among officials of the Mexican Government.

Mexican Pacific.—The projectors of this enterprise are also reported to be engaged in a factional fight rather than in pushing work on their proposed railway. WM. MC WOODS, of San Francisco, who holds the concession, is in London endeavoring to enlist British capital for his work. Another dispatch states that the locating survey is now in progress between Tonala and Mal Paso, that grading is to begin in March, and that W. H PRICHARD represents the company in the city of Mexico.

Michoacan.—This English company which proposes to build a railway from Maravatio, on the Mexican National Ry., to Iguala, on the line of the Mexican Inter-oceanic Ry., is now floating its securities in London.

Greece.—The Piræus, Athens & Peloponnesus Ry. Co. is marketing bonds in England to complete the line from Patras to Pyrgos, 69¼ miles, of which about one-fourth is now completed and open for traffic.

India.—The Delhi, Umballa & Kalka Ry. is to be built from Delhi to Kalka, 157¼ miles. The work will be done by native contractors. The estimated cost of construction is about $20,000 per mile, and three years will be required to build it.

RAPID TRANSIT.

Street Railways.—***Nashville, Tenn.***—The Chicago syndicate which has purchased the street railways in Memphis is reported to be negotiating for the purchase of the Nashville lines.

Dayton, Tenn.—Work on the first 2 miles of the new street railway will be commenced March 1. JOHN M. HOWARD is interested.

Jeffersonville, Ky.—The Ohio Falls Street Ry. Co. has decided to begin work on its line as soon as possible.

Pomeroy, O.—Col. DAVENPORT, who has franchises for a street railway and water-works, expects to begin work soon. T. Wm. Harris & Co. of New York City are the engineers.

Englewood, Ill.—The Englewood & South Park Street Railway Co. of Chicago has been organized by E. O RUSSELL, H. DUNLEVY, and WM. H. ALLEN. Capital stock, $200,000.

Riverside, Cal.—Street railway franchises have been applied for by J. S. CASTLEMAN, THOMAS BAKEWELL, and L. C. TIBBETTS.

Port Townsend, Wash. Ty.—A street railway is to be built by T. J. DOOLY and others.

Dummy Lines.—***Nashville, Tenn.***—HIRAM VAUGHN is interested in 3 dummy railways. Separate companies will be organized.

Bessemer, Ala.—The Birmingham, Powderly & Bessemer Ry. Co. has had the surveys made for its line.

Blountsville, Ala.—A dummy line is to built from Blountsville to Bangor, on the Louisville & Nashville, 12 miles. A. E. FIELDS is president of the company and A. J. KETCHUM is Secretary.

Cable Railways.—***Denver, Col.***—The Denver City Cable Co. has let contracts for boilers and two driving engines of 1,200 and 1,400 H. P. Construction will be commenced soon, and some sections of the system are expected to be in operation by September.

Seattle, Wash. Ty.—The cable roads are under construction, and one section of about 5 miles is in operation. J. M. THOMPSON, who is at the head of the project, has been granted a franchise for additional streets.

Electric Railways.—***Camden, N. J.***—An electric line to Haddonfield is projected.

Cleveland, O.—The Euclid Ave. line, which is operated on the Sprague system, has proved very successful, and it is proposed to introduce the system on other lines.

St. Joseph, Mo.—The Union Street Railway Co. proposes to increase its capital stock from $150,000 to $250,000, and to adopt some electric system.

Kirkwood, Mo.—Some St. Louis capitalists have applied to the county court of St. Louis county for a franchise for an electric line to Kirkwood.

Seattle, Wash. Ty.—The Seattle Electric Ry. & Power Co. has received its stationary plant and 4 motor trucks. The poles are up, and the line will be in operation shortly.

Sacramento, Cal.—The Electric Street Railway Co., L. L. LEWIS president, must by the terms of its franchise begin work in 6 months, and use a side-bearing rail. The company has ordered 5 more storage cars from the Electric Accumulator Co. which controls a system differing from that of the Julien company.

Fort Worth, Tex.—The North Side Street Railway Co. has contracted for the equipment of about 10 miles of road. There will be two 75 H. P. engines in the power house.

CONTRACTING.

Dredging.—The following was the only proposal received January 28, by Capt. W. M. BLACK, U. S. Engineer Office, St. Augustine, Fla.: Alabama Dredging & Jetty Co., Mobile, Ala.; 45 cts per cu. yd. for Manatee river, 48 cts. for Tampa bay, 40 cts. for Cedar Keys harbor.

The following proposals in lump sums were received January 31, by JOHN P. ADAMS, Commissioner of City Works, Brooklyn, N. Y., for dredging in the slips at the foot of Main and Gold streets respectively: Henry E. DuBois, $750 and $250; Morris & Cummings Dredging Co., $745 and $245.

Pipe.—***Newark, N. J.***—The Executive Committee of the Aqueduct Board has received the following bids for 25,000 ft. of 6-in. pipe: McNeal Pipe & Foundry Co., Burlington, N. J., $25.25 per gross ton; R. D. Wood & Co., Philadelphia, Pa., $25.94; Warren Foundry & Machine Co. $25.90; M. J. Drummond, $26. The contract was awarded to the McNeal Pipe & Foundry Co.

Allegheny, Pa.—The contract for pipe and specials has been awarded by JAMES BROWN, Comptroller, to the National Pipe & Foundry Works, Scottdale, Pa., at $27.65 per ton for pipe and 2¼ cts. per lb. for castings.

Cleveland, O.—The following proposals for 5,300 ft. of 36-in. pipe and specials, and for 3 to 12-in. pipe and castings required during the year, were opened Feb. 6 by JOHN WHITELAW, Secretary of the Water-Works Trustees.: Lake Shore Foundry, Cleveland, O.: $25.25 per ton for all pipe, 3½ cts. per lb. for 36-in. castings, and 2¼ cts. for other castings;——New Philadelphia Pipe Co., New Philadelphia, O.: $25.70 for pipe, 2¾ cts. for specials;—— Dennis Long & Co., Louisville, Ky.: $27.50 per ton for 12-in. pipe, $27.15 for all other sizes, 3 cts. per lb. for specials;——Buffalo Cast Iron Pipe Co., Buffalo, N. Y. $27.50 for pipe;——Addyston Pipe & Steel Co., Cincinnati O.: $28.75 for 3 to 12-in. pipe, $27.50 for 36-in., 3¾ cts. for

specials. The contract was awarded to the Lake Shore Foundry.

Depot.—W. E. Huston of Lockport, N. Y., has been awarded the contract for the new depot for the New York Central at that place.

Piles.—The following proposals for 200 yellow pine, white pine, spruce or cypress piles, 50 to 55 ft. long, have been received by the Docks Department, New York City: Alfred J. Murray, $5.50 each; Beard & Kempland, $5.75. The contract was awarded to A. J. Murray.

Pile Protection.—The Harbor Commissioners, San Francisco, Cal., have awarded to the Pacific Paint Co. a contract for treating 500 piles with the company's patent covering at 38 cts. per lin. ft.

Reservoir.—The Finance Committee of Councils, at Buffalo, N. Y., recently considered the advisability of having the construction of the Tifft farm reservoir done by the city instead of by contract, and finally adopted a resolution recommending that the Water Commissioners be authorized to advertise for bids for constructing a new reservoir on the Dodge farm, according to plans on file in their office; and that a clause be inserted in the contract that no laborers be paid less than $1.50 per day, and no person be employed who has not been a resident of the city for 6 months previous to the letting of the contract. The report was adopted. The reservoir will cover about 22½ acres, and will have a capacity of about 125,000,000 galls.; its depth will be from 35 to 41 ft. It will double the pressure in the eastern and northeastern portions of the city and also increase the pressure on the west side. The work will cost about $300,000 and will occupy 2 or 3 years. Mr. KNAPP is Superintendent of the Water Department.

Sewers.—*Newark, N. J.*—Contracts were awarded as follows, on Feb. 5, by ERNEST ADAM, City Surveyor: Walnut St. sewer: James Maguire, 80 cts. per ft. for 800 ft. of 15-in. pipe, $22 each for 5 manholes, and $100 each for two receiving basins.—So. 8th St. sewer: James Maguire, $1.20 per ft. for 800 ft. of 18-in. pipe, 95 cts. for 850 ft. of 15-in., 80 cts. for 750 ft. of 12-in., $100 each for 3 receiving basins, $27 each for 6 manholes.—Second St. sewer: P. H. Harrison, 82 cts. per ft. for 630 ft. of 12-in. pipe, $1.50 per ft. for 20 ft. of 15-in., $28 each for 4 manholes, $96 for 1 basin.

Los Angeles, Cal.—The City Council has awarded to Frick Bros. the contract for an 8-in. vitrified clay pipe sewer, at $1,38[illegible]4 cts. per lin. ft.

Street Work.—*Allegheny, Pa.*—The Street and Sewer Committee has awarded to Thomas Carson a contract for grading Lamont St. at $1.15 per cu. yd.

Springfield, O.—City Engineer MOLER has completed an estimate for the Board of Trade for paving the streets and curbing and paving the sidewalks on each side of the new city building. There are 3,941 sq. yds. of street to be paved, 821 sq. yds. of sidewalk, and 1,848 lin. ft. of curbing, costing according to this estimate, if granite or Medina stone is used, $15,565.60, and if West Virginia paving blocks are used the total cost will be $12,073.60.

Los Angeles, Cal.—The City Council has awarded contracts as follows: Gray Bros. Artificial Stone Paving Co., 12½ cts. per sq. ft. for cement sidewalk, 38 cts. per lin. ft. for cement curb; C. C. Adams, grading, gravelling, and redwood curb, $4.48 per lin. ft.; J. M. Witmer, similar work, $4.80 per lin. ft.; A. S. Heitchen, similar work, $1.90 per lin. ft.; D. F. Donegan, similar work, $2.15 per lin. ft.

West Troy, N. Y.—An appropriation of $32,700 has been made in the Legislature for paving Broadway, in front of the Watervliet arsenal, with granite blocks.

Pensacola, Fla.—P. M. B. Young of Atlanta, Ga., has made a proposition to pave the principal streets of the city.

Paris, Tex.—Wooden block paving is to be laid on certain streets. The contracts have not yet been awarded.

PROPOSALS OPEN.

Union Depot.—At Pueblo, Col. Estimated cost, $200,000. S. T. SMITH, General Manager, Denver & Rio Grande R. R., Denver, Col.

Electric Lighting.—Incandescent lights for streets at South Chester, Pa. The post-office address is Thurlow, Pa.

Gas Works.—For illumination, heat and power; to be leased to the city. Works to be completed by January, 1890. GEO. W. ALLEN, Mayor, St. Louis, Mo.

Sewer.—Main sewer and appurtenances, in Wabash Ave. Length, 4,127 ft., of sizes from 20-in. pipe to 3 ft. 6 ins. by 5 ft. 3 ins. brick, inside measurements: also 12 manholes, 26 catch-basins, and an outfall at the river. GEO. H. SIMPSON, City Civil Engineer, Terre Haute, Ind. February 19.

Dredging.—In the Wallabout channel and basin. Plans and specifications on file. JOHN P. ADAMS, Commissioner of City Works, Brooklyn, N. Y. February 20.

Railway.—Grading 9½ miles of the Chicago, Kansas City & Texas; about 200,000 cu. yds. JAMES R. CHAPMAN, Chief Engineer, Kansas City, Mo. February 20.

Stone Arch Bridge.—At Roger William's park; cut granite; 30 ft. span, 37 ft. wide; with wing walls; all on pile and platform foundation. Plans and specifications on file in the City Engineer's office. S. H. MANCHESTER, Chairman of Park Committee, Providence, R. I. February 21.

Street Work, Sewers and Building.—Flagging and curbing, sewers, keeper's house at Williamsbridge reservoir. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. February 21.

Crib-Bulkhead.—At foot of E. 53d St., East River. THE DOCKS COMMISSIONERS, Pier A, North River, New York City. February 21.

Sewage Disposal.—For a term of 5 years. W. B. DENNETT, City Clerk, Fresno, Cal. February 25.

Paving.—Asphaltic compound paving 22,350 sup. yds., also 6,500 sup. yds. of Medina stone or granite block paving and 8,110 lin. ft. of stone curbing. Plans and specifications on file. GEO. H. SIMPSON, City Civil Engineer, Terre Haute, Ind. February 26.

Gate House.—Roof, doors, windows, etc., for Ardsley gate house. JAMES C. DUANE, President, Aqueduct Commissioners, 280 Broadway, New York City. February 27.

Machine Shops.—Erecting shop, machine shop, boiler shop and smith shop; at Altoona, Pa. WM. H. BROWN, Chief Engineer, Pennsylvania R. R. Co., 238 So. Fourth St., Philadelphia, Pa. February 28.

Water-Works.—Plans and specifications prepared by W. B. C. DURYEE, GEO. R. FAIRBANKS, Chairman, Board of Public Works, Fernandina, Fla. February 29.

Street Work and Sewer.—Grading and paving, pipe sewer. MARTIN FINCK, Clerk, Board of Public Works, Jersey City, N. J. March 4.

GOVERNMENT WORK.

Dredging.—In Black Rock harbor, Conn. Lieut. Col. D. C. HOUSTON, U. S. Engineer Office, New York City. March 13.

Dredging Plant.—Hire of dredging plant for work in the Housatonic river, Conn.; Connecticut river, Conn.; and Five-Mile River harbor, Conn. Lieut. Col. D. C. HOUSTON, U. S. Engineer Office, New York City. March 13.

MANUFACTURING & TECHNICAL.

Market Prices.—*Steel Rails.*—New York, $27 @ $27.50; Pittsburg, $28; Chicago, $30 @ $30.50.

Railway Track Supplies.—New York: spikes, $2 @ $2.10; angle bars, $1.80 @ $1.85.—Pittsburg: spikes, 2.05 c. @ 2.10 c.; splice bars, 1.75 c. @ 1.80 c.; track bolts, 2.75 c. with square and 2.85 c. with hexagon nuts.

Structural Iron.—New York: sheared plates, 1.9 c. @ 2 c.; universal mill plates, 2 c. @ 2.1 c.; angles, 2 c. @ 2.10 c.; tees, 2.4 c. @ 2.6 c.; channels and beams, 2.8 c.—Chicago: mill lots, angles and sheared plates, 2.12½ @ 2.15 c. universal plates, 2.20 c.; tees, 2.45 c. @ 2.55 c.; beams and channels, 2.90 c.; store lots, 2.35 c. for angles, 2.70 c. for tees, 3 c. @ 3.4 c. for beams and channels. (Compiled from *The Iron Age*, Feb. 14.)

Building Materials.—Bricks are not plentiful and prices are firm. Haverstraw hard, $8 @ $8.25 per 1,000; Long Islands, $7.25 @ $8; Staten Islands, $7.62½ @ $8; Jerseys, $6.75 @ $7.50; Pale bricks, $3 @ $3.50; Croton, dark and red, $15 @ $16; Croton, brown, $14 @ $15; Philadelphia front, $28; Trenton front, $27.—Rosendale cement, $1.15 @ $1.25; American Portland, $2.10 @ $2.30; English Portland, $2.20 @ $2.30; German Portland, $2.30 @ $2.70.—Rockland common lime, $1 per bl., and do. finishing, $1.20; State common lime, 85 c., and do. finishing, $1.10. Laths, $2.25 @ $2.30 per 1,000. Hair is quiet; goat's hair, 25 c. @ 30 c. per bushel; cattle hair, 18 c. @ 21 c.

The Hyatt Filter System has been adopted at Washington, Mo.; Camden, Ark.; Sedalia, Mo.; and Mount Pleasant, Ia.

The Standard Railway Signal Co. has been incorporated at Columbus, O., with a capital stock of $10,000.

Wire Tramways.—The Trenton Iron Co. of Trenton, N. J., is manufacturing tramways for South America and Mexico.

Rails.—Steel rails are about $25 per ton in England.

Exhaust Pipe.—The Smith triple-expansion exhaust pipe is in use on several locomotives in New England. The inventor is J. Y. Smith of Doylestown, Pa.

Motor Brush.—The Thomson-Houston Co. states that on one of its motors on the electric railway at Wichita, Kan., a copper brush was in use for 65 days, the car traveling 4,300 miles in that time.

Chrome Steel.—The Chrome Steel Works, of Brooklyn, N. Y., manufacture this class of steel, in which chromium is substituted for carbon, and which is said to be of a very high degree of hardness while at the same time it is tough and can be welded and worked in large masses. It can be made ductile and soft by the use of chromeisen instead of spiegeleisen in the Siemens process. Its hardness makes it especially useful for tools, dies, safes, gratings, etc.

Hinkley Locomotive Works.—These works, at Boston, Mass., were put up at auction February 7, but no bids were received above the mortgage and the property was withdrawn. The property is assessed for $369,000 and mortgaged to the Suffolk Savings Bank for $15,000, the works being in operation, and the whole plant, stock and machinery being estimated by many to be worth $500,000 in good times. The works were started in 1845 by Hinkley & Drury, and won a wide reputation, furnishing not only the home roads, but many Western and Southern roads, including the Union Pacific, with their power, until locomotive works were established nearer the scene of operations. The original proprietors having suspended during a season of general panic many years ago, the establishment remained idle for a few years, but upon the decease of both, the Hinkley Locomotive Mfg. Co. was formed and has operated the plant. Several locomotives are nearly ready for delivery on orders.

Trade Note.—The Clayton Air Compressor Works, New York, report business good. A number of compressors have been supplied for running machines underground, in mines, etc. They are also manufacturing a small, vertical, high-pressure, belt air-pump, used in connection with the burning of crude petroleum for fuel.

Timber and Stone.—The Cornwallis Valley Ry. Co. is prepared to make contracts for bridge timber, plank, ties and fence posts; also stone for culverts. President S. SHEFFIELD; Secretary, D. M. DICKIE, Canning, Nova Scotia.

Traction Engine.—Roberts & Doan of Sacramento, Cal., manufacture a very peculiar type of traction engine. The cylinders are about the middle of the boiler and are inclined; they are 19 ins. diameter and 40 ins. stroke, driving a single leading wheel 6½ ft. diameter, which is connected by coupling rods to 2 rear wheels. One of these engines has been in use for 2 years, hauling lumber. Its average speed is 3½ miles per hour up grades of 216 ft. to 430 ft. per mile.

Locomotives.—The Mason Machine Works of Taunton, Mass., are not building locomotives at present, as they find that business unprofitable. They recently declined an order for 2 "bogie" engines for the Boston, Revere Beach & Lynn, and the order was given to the Taunton Locomotive Mfg. Co., the Mason Works furnishing the patterns and drawings which have been used by them in building former engines of this type.

The Manchester Locomotive Works of Manchester, N. H., have built some heavy freight engines for the Boston & Maine.

The Rogers Locomotive Works of Paterson, N. J., are building 7 engines for the Long Island road.

The Baldwin Locomotive Works of Philadelphia, Pa., are building 3 moguls for the Marietta & North Georgia.

The Schenectady Locomotive Works of Schnectady, N. Y., are building 5 switching engines for the Long Island.

The Chicago & Alton has built a 10-wheel engine at its shops at Bloomington, Ill. It is a passenger engine and will be run on the Kansas City division. The driving wheels are 64 ins. diameter, and the truck wheels 28 ins. The cylinders are 18 x 24 ins. The boiler is 24 ft. long, 54 ins. in diameter, and has 218 flues. The length of the flues is 13 ft. 5 ins. The total heating surface is 1,635 sq. ft. The fire-box is 90 ins. long and 42⅜ ins. wide. The engine is equipped with the Westinghouse brake, and Supt. WILSON'S spark arrester.

The St. Louis, Vandalia & Terre Haute will order 6 freight engines.

Fairlie Locomotives.—The Yorkshire Engine Co., England, has an order for new boilers for the Fairlie engines of the Nitrate Ry. Co., in Chili. The original boilers were supplied by the engine company 14 years ago.

Railway Material—Steel rail, track fastenings, equipment, etc., are wanted by FRED T. LOCKWOOD of Augusta, Ga., for a railway from Dover to Excelsior, 28 miles.

Ties.—Lutcher & Moore of Orange, Tex., have the contract for 80,000 ties for the Monterey & Tampico line, in Mexico.

A Traction Engine, of 16 H. P., is wanted by GILLILAND & HETEMAN of Abilene, Tex.

Tramway.—The Simpson's Ferry Tramway Co. has been organized to build a tramway from Covington, Tenn., to Simpson's ferry, on the Hatchie river, about 10 miles. The road will develop timber lands. W. C. BOYCE, WM. SANFORD, and J. C. ROALS are interested.

Car Notes.—The Peninsula Car Works, Detroit, Mich., are building 250 box cars for the Wabash.

The Litchfield Car Works, of Litchfield, Ill., have an order for 250 box cars, of 50,000 lbs. capacity, for the Cincinnati, Hamilton & Dayton.

The St. Charles Car Co. of St. Charles, Mo., is building 500 freight cars for the Mexican National.

The Haskell & Barker Co., of Michigan City, Ind., has an order for 250 box cars for the Wabash.

The Limerock Ry., of Rockland, Me., has ordered 125 new freight cars.

The Hudson Connecting Ry. has had 4 more cars delivered at Campbell Hall, N. Y.

The New York, Chicago & St. Louis, and the Toledo, St. Louis & Kansas City are receiving proposals for freight cars.

Granite.—The Maine Granite & Improvement Co. has a $70,000 contract for dressed granite for Prospect Park, Brooklyn. The present contract is mainly for entrances to the park, with some side walls, and calls for some polished and carved work. Both red and gray granite will be used.

Spikes.—The Standard Spike Works of Richmond, Va., will be completed and in operation next month. The works will manufacture railroad spikes, dock spikes, and ship spikes, the capacity being from 75,000 to 100,000 kegs of 200 lbs. each per annum.

Steel Rail Shipments for 1888.—North Chicago Rolling Mill Co., 161,945 tons; Carnegie Bros. & Co., 138,946 tons; Scranton Steel Co., 136,029 tons; Lackawanna Coal & Iron Co., 128,310 tons; Union Steel Co., 126,016 tons; Pennsylvania Steel Co., 126,960 tons; Joliet Steel Co., 114,675 tons; Bethlehem Iron Co., 85,448 tons; Cambria Iron Co., 82,363 tons; Western Steel Co., 39,168 tons; Cleveland Rolling Mill Co., 29,940 tons; Troy Steel & Iron Co., 25,110 tons; Worcester Steel Co., 6,569 tons; Springfield Iron Co., 3,705 tons. Total, 1,200,184 tons.

Creosoting Works.—E. W. CLARKE of Washington, D. C., proposes to establish creosoting works at Mobile, Ala.

The National Forge & Iron Co. will establish a new rolling-mill plant at Chicago, for the manufacture of axles, fish-plates, structural iron, and plates. Capital stock, $250,000. President, MARKS SWARTS; Manager, W. J. QUAILEY.

Iron Output.—The North Chicago Rolling Mills, in one day of 24 hours last week, turned out 801 tons of direct metal, 629 tons of cupola metal, a total of 1,430 tons; 1,393 tons of ingots and 3,750 tons of 75-lb. steel rails.

Steel Tires.—The Midvale Steel Co. of Philadelphia, Pa., has the contract to supply all tires for the current year to the New York Central and West Shore roads.

The Harrington Semaphore Signals are manufactured by the Barney & Smith Mfg. Co. of Dayton, O.

The Sanitary Sewer Pipe Co. has filed articles of incorporation at St. Paul, Minn. The company will manufacture gas, water, and sewer pipe under the patents owned by Gleich, Krause & Co. Capital stock, $300,000. President, R. D. O'CONNELL; Vice President, MICHAEL MURPHY; Secretary, EDWARD HINDERER.

The International Water Purification Co. has been incorporated by JOHN SIMONDS of New York, A. R. LEEDS of Hoboken, N. J., and WM. M. DEUTSCH of Elizabeth, N. J. Capital stock; $100,000. The works will be erected in Newark, N. J.

Cement.—The cement production of the Rosendale cement district in Ulster county, N. Y., for the year 1888 was 2,262,984 barrels, a decrease from the production of 1887 of 75,760 barrels.

Crossing Gates.—The Jonson Foundry & Machine Co. of New York has a contract with the Delaware, Lackawanna & Western, to erect gates at crossings in East Orange. They will be raising arm gates, the same as are used at other stations, but of unusual length.

Wheelbarrows.—P. K. DEDERICK & Co. of Albany, N. Y., have brought out a new barrow for contractors' use. The sides and bottom are of steel, flanged and riveted; the handles and legs are of wrought-iron pipe, and the wheel has a cast-iron hub and rim, with wrought-iron spokes and steel axle.

BRIDGES AND CANALS.

Bridge Notes.—*Oneonta, N. Y.*—The new iron highway bridge over the Susquehanna is nearly finished; there are two spans, 165 ft. and 70 ft. respectively.

Albany, N. Y.—The bids for a lift bridge at North Ferry St. were as follows: Hilton Bridge Co., $9,375; Rochester Bridge & Iron Co., $9,500; King Iron Bridge & Mfg. Co., $10, 927. Contract let to the Hilton Bridge Co.

Waterford, N. Y.—The following were the bids for a lift bridge at Grand St.: Ira Parker, of Waterford, $1,908; V. Brown, of Mohawk, $2,491; Sturtevant & Gibson, of Sandy Hill, $3,592. Contract awarded to I. Parker.

Beaver Falls, Pa.—A company has been organized to build an iron bridge of 3 spans over the Beaver river; it will cost $40,000.

McKeesport, Pa.—The McKeesport & Duquesne Bridge Co. has applied for a charter. Dr. T. S. WHITE is President. The capital stock will be $30,000, but if the McKeesport & Bessemer Ry. Co. joins in and a double-deck—railway and wagon—bridge is built, the capital will be $100,000.

Louisville, Ky.—The Kentucky & Indiana Bridge Co. will issue $600,000 of bonds, about $200,000 of which will be used in completing the double tracking of the Belt road and in erecting a steel trestle in place of the wooden one on the Kentucky side.

Gadsden, Ala.—The Coosa river bridge is completed and the draw is now in operation.

New Orleans, La.—The Southern Bridge & Railway Co. has been incorporated, with a capital stock of $1,000,000, to build a bridge across the Mississippi. E. L. CORTHELL of Chicago is the engineer.

Detroit, Mich.—The Senate Committee on Commerce has adopted a resolution requesting the Secretary of War to appoint a board of three army engineers to investigate and report upon the practicability, necessity, and best plan of a bridge across the Detroit river.

Walton, Mich.—The new bridge on the Grand Rapids & Indiana Ry. has been tested and accepted.

Chicago, Ill.—A bridge over the Chicago river at Washington St. is projected. Plans have been prepared by Capt. HARMON.

Grand Forks, Dak.—The bids received, February 4, by the City Council for 2 bridges across Red river ranged from $50,000 to $80,000.

Kansas City, Mo.—An ordinance has been passed appropriating $3,000 for a bridge over O. K. creek at Bullene Ave.

Kansas City, Kan.—It is thought probable that the 4 Wyandotte county bridge bills before the State Senate will pass. The bills are for a combination wagon and railway bridge across the Missouri river at Quindaro and the bridges across the Kaw at Osage Ave., 8th St. and Bonner Springs. The latter bridge will be built jointly by Johnson and Wyandotte counties.

Fort Smith, Ark.—The Missouri Ry Co. will build its bridge over the Arkansas river this year.

Holbrook, Neb.—It is proposed to build a county bridge across the Republican river at Holbrook, 6 miles from Arapahoe.

Winchester, Ore.—The Umpqua river bridge has been completed and accepted.

Snohomish, Wash. Ty.—A steel bridge is to be built across the Snohomish river. E. M. STIXERD is in charge.

Cuero, Tex.—The County Commissioners of De Witt county propose to build two bridges.

The Keystone Bridge Co. of Pittsburg, Pa., is building iron bridges for the Western New York & Pennsylvania as follows: 1 span of 128 ft. at Portville, N. Y., 1 span of 152 ft. at Larrabee, 2 spans of 300 ft. at Petroleum Center; an iron bridge with 2 spans of 300 ft. has been completed at Oil City, Pa.

Piers.—The Docks Department, New York City, will build two fine piers and a stone bulkhead for dock room on the site of the old West Washington market.

Canals.—The Delaware & Maryland canal is to be built by Philadelphia parties.

The Chesapeake & Delaware ship canal scheme is approved of in Baltimore, and Congress is to be asked for aid.

The Sault Ste. Marie water power canal, at Sault Ste. Marie, Mich., is progressing. Piling and rock excavation are going on and about 100 men are at work.

The Cornwall canal (Canada) is to be strengthened at the places where the breaks occurred in October last, and contracts will be let shortly.

Work on the locks of the New York State canal at Amsterdam, N. Y., is progressing rapidly.

ELECTRICAL.

Electric Light.—*Bangor, Me.*—The city has voted to contract with the Brush Electric Light Co. for an electric light plant of 165 lights; power to be obtained from the Bangor water-works. The contract price is $25,000, and it is agreed that the plant shall be established within 90 days from signing the contract. The Hinckley & Egery Iron Co. will furnish the machinery.

Rockland, Me.—The Rockland Electric Light & Power Co. has contracted with the Eastern Electric Construction Co., of which GALEN C. MOSES of Bath is president, and F. A. SAWYER of Portland is treasurer, for a complete arc and incandescent plant on the Thomson-Houston system. A brick station will be built in the spring.

Middletown, N. Y.—Three companies have made propositions to establish an electric light plant.

Oneida, N. Y.—The question of issuing bonds for $3,000 for establishing an electric light system has been carried by a vote of 267 for and 46 against.

Orange, N. J.—The Essex Electric Light Co., a local corporation, has acquired the entire plant of the Excelsior Electric Light Co. The price paid was $35,000 or $40,000. There are two Ball engines of 60 and 80 H. P., a Hazeltine boiler of 150 H. P., and five dynamos. This will furnish power for 225 arc lights, 184 of which are now in use, and 6 more ordered; private parties use 10. Another dynamo can be used, giving 70 more lights than are now used. The following are the officers of the new company: President, EDWARD E. SAGE; Secretary, CHARLES A. LINDSLEY; Treasurer, WILLIAM B. BOULTON; General Manager, STUART LINDSLEY.

Winchester, Va.—The Winchester Gas Co. has been awarded the contract for lighting the city with 40 arc lights of 1,500 c. p. for $70 per lamp, to run every night until midnight. The system to be used has not been decided upon, but the contract calls for a "white" light. The only other bid was from the Schuyler Co., at $80. C. E. HOOVER is Superintendent of the gas company.

Charleston, W. Va.—The Charleston Electric Light Co. has notified the city that its contract for street lights has expired, and that it would not be renewed for less than $7 a month for each light, an increase which would make the cost of the lamps amount to about $3,500 per year. A proposition has been made to the company to furnish 42 lights for the sum of $3,000 per annum.

Salisbury, N. C.—The city is contemplating the issue of bonds to pay for an electric light plant.

Cedartown, Ga.—The Empire Water, Light & Mfg. Co. will put in an electric light system. CHAS. P. HALL and J. H. MEAD are interested.

Taylorville, Ill.—The Taylorville Electric Light & Power Co. has been incorporated by W. H. KIRKWOOD, J. BOURNE, and W. W. ANDERSON. Capital stock, $20,000.

Duquoin, Ill.—GEO. F. BLAKESLEE, proprietor of the Duquoin Iron Works, has applied for an electric light franchise.

St. Louis, Mo.—The plans for the electric lighting systems, proposals for which are now being received, provide for arc lamps to be placed at alternate intersecting streets, or two blocks apart, so that each lamp shall have a field of one block in each direction. For blocks of over 400 ft. and under 800 ft. in length, lamps are to be put at each intersecting street. When the blocks are over 800 ft. in length, the lamps will be put as near 800 ft. apart as possible. On the suburban roads the lamps are to be put 1,000 ft. apart. In case the Municipal Assembly sees fit to have the alleys lighted, incandescent lamps of 35 c. p. each will be placed near the middle of the block in the alley.

Victoria, Tex.—An electric light plant has been decided upon, but no system has yet been adopted.

London, Ont.—The contract for street lighting expires April 1, after which it is proposed to light the entire city by electricity. City Engineer TRACY has prepared a plan with this object in view, according to which 40 additional lights will be required, bringing the total up to 125 for the whole city.

Electrical Companies.—The Wisconsin Storage Battery Co. has been incorporated at Milwaukee, Wis., by DEWITT DAVIS, H. C. WEST, and others. Capital stock, $50,000.

The Mystic Electric Motor Co. has been organized at Portland, Me. Capital stock, $100,000.

WATER AND MUNICIPAL.

Irrigation.—*Texas.* The Grand Falls Irrigation Co. has been incorporated at Pecos City by D. K. TAYLOR, L. C. HARDEMANN, and others, to build an irrigation canal 35 miles from the city. Capital stock, $10,000.

Colorado.—The Montezuma Water Supply Co.'s ditch, to bring water from the Dolores river into the Montezuma valley, has been sold to J. P. BAXTER of Portland, Me. The tunnel, 1 mile long through the mountain, was finished while the company was in the hands of a receiver, and it is hoped the ditch will also be completed. ——Colt, Rhinehart & Burk of Pueblo have a contract for a canal 40 miles long in Bent Co.——The Pueblo & Chico Ditch Co. has been organized to build a canal 55 miles long from the Arkansas river near Cañon City to a reservoir near Pueblo. W. P. HONSON is the engineer. ——The Pueblo & Rocky Ford Canal Co. has been incorporated by W. B. GOBIN, BERGER PADFIELD, and others. Capital stock, $200,000.

California.—The Orland Southside Irrigation District received proposals, Feb. 5, for $50,000 bonds. L. P. BEHRENS is Clerk of the Board of Directors.——Engineer GRUNSKY has made surveys for the canals of the Kraft Irrigation District in Tehama Co.

Kansas.—The Seward County Ditch Co. has been granted a charter. The company has a capital stock of $30,000, and proposes to build an irrigating ditch 30 miles in length, from the Cimarron river southeast to where the river intersects the State line in Meade county. The directors are FRED OCHSNER, C. W. SHORE, and E. BARNARD, of Arkalon.

Drainage in Illinois.—Mr. JACOB A. HARMAN, C. E., of Watseka, Ill., has received word from Mr. ECKHART, the attorney for the Tuscola, Arcola and Bowdre townships Drainage District, that the Commissioners of the district have received an order from the county court of Douglass county to proceed with their proposition to improve about 4 miles of Scattering Fork.

Artesian Wells.—*Newark, N. J.*—The city authorities propose to investigate the question of a water supply from driven wells.

Charleston, N. C.—A new artesian well has been completed: it is 1,825 ft. deep and flows 300 galls. per minute. It is the largest of the 3 deep wells and cost $40,000.

Beebe, Ark.—A supply of water from artesian wells is projected. Address F. P. LAWS.

Sonoma, Cal.—Another artesian well has been put down. It is a 6-in. well and flows 36,000 galls. per day. It is the fourth put down in the city.

Nevada.—A number of wells were bored in Humboldt county during 1888, and though none of them have been bored to any great depth, a fine flow of water has been encountered in every instance.

Brasil, S. A.—The Brazilian Minister of Agriculture, at Rio de Janeiro, contemplates having wells put down in the province of Ceara for furnishing a supply of water for irrigation and domestic purposes, as the province suffers severely from periodical droughts.

Street Cleaning.—At St. Louis, Mo., the Board of Improvements has awarded the street-sweeping contracts to David Josephs for granite and wood blocks, and to Henry Heman for asphaltum, at lower prices than were ever before bid. Mr. Josephs will use a new self

oading machine in carrying out his contracts, and its use is expected to save the price of half the force of gutter men, whose labor has heretofore cost him $75 per day. The new machine is said to be used in the East for executing street-sweeping contracts taken at 30 cts. per 10,000 sq. ft. Street Commissioner BURNET was the first man in St. Louis to give consideration to the new machine.——At New Orleans, La., no bids were received by the Commissioner of Public Works in answer to advertisements for proposals for cleaning the streets by contract.

Syracuse, N. Y.—The Water Commission, in its report to the City Council upon the future water supply of the city, has recommended Skaneateles lake as the source of supply. The Commission also recommends municipal ownership and proposes that the city should issue bonds for the funds for constructing the necessary works. The wells sunk by the Syracuse Water Co. are not considered as an adequate source, but it is proposed to buy up the water company's plant.

Taunton, Mass.—The report of the Board of Water Commissioners for the year ending Nov. 30, 1888, has recently been published. A new 20-in. main has been laid over the Dean St. bridge and the defective pipe under the river disconnected; this is estimated to have effected a saving of 50,000 galls. of daily leakage and a financial saving of $208.11, more than twice the interest on the cost. In September the water was very rolly and dirty, and the mains were flushed out. On the whole, the quality of the supply has been satisfactory. Five plans for an increased water supply are suggested and described. The Commissioners recommended the closing up of the dead ends. There were at the date of the report 55.86 miles of mains, 487 hydrants and 9 gates. For increasing the supply it is proposed to take water from Assawompsett or Elder's pond, to extend the conduit, to put in a plant to filter the river water, or to establish a supply from wells. The cost of pumping was $19.45 per 1,000,000 galls. The total pumpage was 275,188,656 galls., and the average daily consumption was 751,882 galls.; 30,100 estimated population supplied. Mr. GEO. F. CHACE is Clerk and Superintendent, succeeding Mr. WM. H. BILLINGS, who resigned to take the position of Manager of the Taunton Locomotive Works.

City Lighting Plants.—A bill has been introduced in the Illinois State Legislature which provides that cities, incorporated towns, and villages shall have power to provide for a supply of gas or electricity for municipal purposes by the construction and maintaining of a system of works, or by uniting with any adjacent city or village in the construction of such works for the joint use of such cities or villages, or by procuring such supply of gas or electricity from any adjacent city, incorporated town or village already having works.

New Orleans, La.—On Feb. 4, Judge MONROE rendered a decision in the suit of E. CONERY et al. vs. the New Orleans water-works in favor of the plaintiffs. The suit was brought by CONERY and others, known as the Committee of One Hundred, to declare null the ordinance providing for a future water supply from the New Orleans Water-Works Co. for the city of New Orleans. A contract was entered into between the city and the company whereby the city agreed to pay for all the water furnished by the company during the term of its charter—$68,000 annually.

Houston, Tex.—The City Council and the Citizens' Committee will apply to the State Legislature for amendments to the city charter providing for the issuance of street, sewerage and drainage improvement bonds, for the extension of time allowed to abutting property owners to pay for street improvements, for keeping the premises and sidewalks in proper condition by property owners, for the enforcement of ordinances by penalties as well as by fines, and for the creation of a Board of Public Works.

Dartmouth, Nova Scotia.—The city has voted in favor of applying to the Legislature for power to borrow a sum not exceeding $100,000 for the purpose of establishing water-works and a sewerage system. Reports on both these proposed works have been made by E. H. KEATING, C. E., of Halifax, N. S. The supply is to be brought to the town from Lamont's lake by a main consisting of 2,450 ft. of 18-in. and 11,000 ft. of 12-in. pipe. The distribution system would consist of 2,200 ft. of 10-in. pipe, 1,850 ft. of 8-in., 5,450 ft. of 6-in. and 2,100 ft. of 4-in. There would be 708 tons of pipe, 5 tons of specials, 24 hydrants, and 22 valves. The total of the estimate of cost is $50,000. The storage capacity of the Lamont and Topsail lakes is estimated at 150,000,000 to 200,000,000 Imperial gallons.——With regard to the sewerage scheme, the district to be drained covers about 100 acres. The sewers are designed of ample capacity to carry away the combined rainfall and house sewage, and, owing to the configuration of the ground, there will be 5 outlets. There will be 9,970 ft. of 9, 12, and 15-in. pipe, and 465 ft. of 18 and 24-in. brick sewer, with 42 manholes. The total of the estimate of cost is $29,500.

Gas Works. — ***Brooklyn, N. Y.***—The following proposals for street lighting have been received by the Commissioner of City Works: Brooklyn Gas Light Co., $19.90 for 3-ft. burner, $36.50 for 4-ft. burner; Williamsburg Gas Light Co., $21.75, $27.60; People's Gas Light Co., $22 $28.24; Citizens' Gas Light Co., $22, $28.24; Nassau Gas Light Co., $22, $28.24; Metropolitan Gas Light Co., $22, $28.24.——The following were the proposals for gas for the public buildings during the year: Brooklyn Gas Light Co., $1.50 per 1,000 cu. ft.; Williamsburg Gas Light Co., $1.60; People's Gas Light Co., $1.60; Citizens' Gas Light Co., $1.60; Nassau Gas Light Co., $1.60; Metropolitan Gas Light Co., $1.60.

Lexington, Ky.—A proposition to build gas works has been made to the Common Council by C. B. HARRIS.

Cleveland, Tenn.—A local company has been organized to build gas works. For particulars address the mayor.

Decatur, Ala.—A local gas company has been organized in the interest of the New York Contract Co. of New York City; the latter company has the franchise for gas works and will begin work very soon. The local company has a capital stock of $200,000.

Rich Hill, Miss.— A contract for gas works has been let to the Shickle, Harrison & Howard Iron Co. of St. Louis, Mo. The gas holder will be 45 ft. diameter. There will be 2 miles of 3-in. cast-iron mains, 2 miles of 4-in. and 3 miles of 6-in.; also 50 street lamps. Sub-contracts have been let to J. A. Scott for excavation and foundation and Guido Jaeger for pipe laying.

Lake View, Ill.—Lake View wants to build its own gas works, and a bill has been introduced in the State Legislature which will authorize the construction.

Burlington, Ia.— The contracts recently made by the city with the gas company provide that the company will furnish gas for one year for not less than 200 public lamps now in place, or to be placed hereafter upon the mains of the company, the same to be lighted according to Philadelphia schedule, and under the same condition as the electric lights in regard to time. The city will pay $18 per annum for each lamp, and $1.50 per 1,000 cu. ft. for the gas furnished in the public buildings.

Water-Works. — ***Massachusetts.*** — North Adams. The Legislature has been petitioned for authority to issue bonds for $150,000 to bring water from Broad brook in Williamstown. The water committee will purchase 24-in. pipe for the main from the reservoir on Broad brook to the city, 7 miles. The cost of the new works will be about $150,000.——Springfield. The question of a new main from the Ludlow reservoir is again under consideration.——Great Barrington. The sale of the property of the Berkshire Heights Water Co. to satisfy the claims of the Deane Steam Pump Co. has been postponed indefinitely.

Connecticut.—Westport. A project for water-works is under consideration.

New York.—Brooklyn. Work has been commenced for clearing the site for the reservoir extension at Ridgewood. A proposition to increase the supply from the wells in the park has been made to the Park Commissioners by JAMES HENDRICK, of New York.——Sing Sing. The Water Commissioners have decided to apply to the Legislature for permission to issue $30,000 of additional bonds, which they find will be necessary to complete the water-works. The original issue was $150,000, but it has been found that the land damages were about double the amount anticipated, that much more rock was found at the Indian Brook reservoir than they thought they would encounter, and a different style of pumping engine was found desirable in order to give the best service to the village.

New Jersey. — Hoboken. A break occurred in the mains last week, causing a large amount of waste from the reservoir.——Burlington. The city proposes to take action to restrain Trenton from emptying its sewage into the Delaware river, from which Burlington takes its water supply.——Newark. The Water Supply Committee of the Common Council is investigating the proposition to procure a water supply from driven wells.

Pennsylvania. — Connellsville. The city will apply for an injunction to restrain the water company from carrying out its proposition to supply water from the Cool Spring reservoir. It is claimed that the water is polluted by sewage and drainage from barns.

West Virginia.—Martin's Ferry. The Water Board will spend $25,000 in extending the water mains.

Florida.—Orlando. The Orlando Water Co. has purchased pipe for extensions.——Tallahassee. A vote will be taken Feb. 19 on the proposition to issue $35,000 in 6 per cent. bonds for constructing city water-works. J. L. DEMILLY, City Clerk.——Fernandina. Proposals will be opened Feb. 20 for building water-works. Plans and specifications have been prepared by W. B. C. DURYEE. GEO. R. FAIRBANKS is Chairman of the Board of Public Works.

Alabama.—Marion. The city will apply to the Legislature for power to issue $8,000 in bonds for water-works.

Tennessee.—Memphis. The Artesian Water Co. will issue bonds to the amount of $750,000.

Kentucky. — Covington. The new water-works will not be completed before October. It is thought, however, that the city can be supplied from one reservoir that will be completed by September.

Ohio.—Pomeroy. Col. DAVENPORT will probably build the water-works this year. The franchise requires him to build the street railway first.

Indiana.— Terre Haute. Nearly all of the Terre Haute water-works stock of $250,000 has been sold to the New York syndicate which has been buying up Western companies, among them the Vincennes and Greencastle companies in this State.

Michigan.—St. John's. A vote will be taken Feb 25 on the proposition to issue bonds for $45,000 to build water-works.——Vassar. The pumping machinery has been tested, but the works will not be in operation for several weeks.

Illinois.—Carlinville. The Carlinville Water Co. has been incorporated by GEO. SIEGEL, F. W. RAEDER, and W. G. REEVE. Capital stock, $75,000.——Peoria. The Council's special committee on the sale of the water-works has been negotiating with Howland & Ellis and with Moffett, Hodgkins & Clarke. The committee is unanimous, in view of the fact that the city has not the means to improve the present water-works system to fully meet all the requirements of the city, that it will be for the best interest of all for the city to dispose of the present system to some private parties or corporation.

Wisconsin.—Ripon. The injunction case in the matter of the water-works has been decided in the Supreme Court in favor of the City Council, and they can now go on and put in the works.

Iowa.— Burlington. The City Council has adopted a resolution requesting the Burlington Water Co. to furnish the names and residences of the persons elected directors at the last annual meeting of the stockholders and the amount of the salary allowed to each; also, the names of the officers elected, including the attorney and superintendent, and the amount of the salary allowed to each; also, to notify the City Council whether or not the company is going to make extensions ordered and directed by the Council, and whether or not it is going to furnish filtered water.

Kansas.—Medicine Lodge. It is proposed to issue bonds for $20,000 to build water-works.

Nebraska.—Fairbury. The city water-works were tested Feb. 2, but have not yet been accepted. The city claims that there should be 5 miles of mains, but the company includes the hydrant connections. The difference is about 700 ft.

Texas.—Decatur. A. R. WHITEHEAD will enlarge the water-works; he has ordered pipe, a 72,000 galls. pump and a 30,000 galls. tank.——Ennis. Work is in progress on the dam. Machinery will not be needed until the autumn. For particulars address the mayor.

Colorado.—Antonito. The Antonito Water, Coal & Gas Co. is putting down an artesian well.——Montrose. The works were tested Feb. 2. The engineer is W. J. FINE, of Montrose.

Washington Territory.—Bellingham Bay. It is proposed to build a system of water-works.

California.—Sacramento. P. A. HUMBERT, Superintendent of the Folsom Water Power Co., has been engaged by Trustees to investigate the water supply system.——Los Angeles. The Packard Water Co. has been incorporated by JAS. BECKETT, P. F. GRIFFIN, and others. Capital stock, $60,000.——Gilroy. There has been considerable discussion over the proposition to issue bonds for improving the water-works. The vote taken Jan. 26, on the issue of bonds for $50,000 for water-works, was favorable. Bids have been advertised for cast-iron pipe and for purchase of bonds, which must be sold at face value and not bear more than 5 per cent.

Special Reports of Water-Works Construction.

Tallahassee, Fla.

The following information has been received from N. M. BOWEN: The water-works question is now being agitated, and a private company is figuring on putting in a system. Election for voting on issuing bonds will be held Feb. 19. B. S. MEGINNESS is chairman of water committee.

Douglas, Wyo. Ter.

Mr. ALEX. BUTLER writes us as follows: The aldermen cannot get anyone to make a bid for putting in water-works. They offer $2,000 to have a well sunk 1,500 ft. If you know of anyone that will come here and make a proposition for water-works or for sinking the well, write to H. R. WILCOX, Alderman. The city has $6,000 in the Treasury and will vote bonds.

Alamosa, Col.

We have received the following information from JESSE H. LEWIS, of Antonito, Col.:—The Antonito Water, Coal & Gas Co. is to lay mains from the San Antonito river to supply Alamosa with water for fire and domestic use. Capital stock, $3,500. C. M. SAMPSON, president. PETER LUND, secretary. C. Y. BUTLER is the engineer. Works will be completed in March. Population, 500.

Roseburgh, Ore.

The following information has been received from N. P. BUNNELL:—Wells now furnish water for domestic use, and there is a small reservoir and 2 hydrants for fire protection. The plan most favored for the new works is to pump water from the river running through the town to a reservoir built on an elevation of 200 ft. Estimated cost, $7,000 to $10,000. A proposition has been made by one of the citizens to establish works, for a rental of $500 the first year. Population 1,500 to 2,000.